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NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

MEGACITIES AND THE PROPOSED URBAN INTERVENTION MODEL

by

A. M.
Jacob A. Allen
Larry P. Graham

June 2016

Thesis Advisor: Heather Gregg
Thesis Co-Advisor: Robert Burks

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As of 2016, 12 percent of the world's population lives in 36 megacities. By 2030, experts estimate that 17 mega regions, hosting 60 percent of the world's population, will account for 75 percent of global GDP. Megacities come with several unique challenges for governance and the provision of services to their populations, as well as for military intervention in the wake of natural or manmade disasters. This thesis asks the question: What do Geographic Combatant Commands (GCCs) and Theater Special Operation Commands (TSOCs) need to know about megacities, and how can they improve the planning process to more rapidly assess, synchronize, and guide military interventions in megacities? The thesis proposes a four-part model—the Urban Intervention Model (UIM)—that allows military leaders to conduct a rapid assessment and plan for military intervention into a megacity in the wake of natural or manmade disasters. It then applies the UIM to a hypothetical case study, the megacity of Cairene following an earthquake, to demonstrate how planning staffs can use the model to plan for military intervention.

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MEGACITIES AND THE PROPOSED URBAN INTERVENTION MODEL

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ABSTRACT

As of 2016, 12 percent of the world's population lives in 36 megacities. By 2030, experts estimate that 17 mega regions, hosting 60 percent of the world's population, will account for 75 percent of global GDP. Megacities come with several unique challenges for governance and the provision of services to their populations, as well as for military intervention in the wake of natural or manmade disasters. This thesis asks the question: What do Geographic Combatant Commands (GCCs) and Theater Special Operation Commands (TSOCs) need to know about megacities, and how can they improve the planning process to more rapidly assess, synchronize, and guide military interventions in megacities? The thesis proposes a four-part model—the Urban Intervention Model (UIM)—that allows military leaders to conduct a rapid assessment and plan for military intervention into a megacity in the wake of natural or manmade disasters. It then applies the UIM to a hypothetical case study, the megacity of Cairene following an earthquake, to demonstrate how planning staffs can use the model to plan for military intervention.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACT	Allied Command Transformation
ADRP	Army Doctrinal Reference Publication
AHP	Analytical Hierarchy Process
ATP	Allied Tactical Publication
AU	African Union
CBR	Case Based Reasoning
CCG	Combat Communications Group
COA	Course of Action
COG	Center of Gravity
CRG	Contingency Response Group
DART	Disaster Assistance Response Teams
ELM	Experiential Learning Model
EU	European Union
FIG	Federation of Surveyors
FM	Field Manual
GCC	Geographic Combatant Command
GDP	Gross Domestic Product
H5N1	Influenza A virus subtype
HA/DR	Humanitarian Assistance and Disaster Relief
HUMINT	Human Intelligence
IED	Improvised Explosive Device
IPOE	Intelligence Preparation of the Environment
ISR	Intelligence Surveillance Reconnaissance
JOPP	Joint Operation Planning Process
JP	Joint Publication
KSIL	Key Strategic Issues List
LRP	Light-based Regional Product
MCDM	Multi Criteria Decision Making

MOE	Measure of Effectiveness
MOP	Measure of Performance
MSW	Municipal Solid Waste
NATO	North Atlantic Treaty Organization
NGO	Non-Governmental Organization
NIC	National Intelligence Council
NSS	National Security Strategy
NVA	North Vietnamese Army
OFDA	Office of Foreign Disaster Assistance
OIC	Organization of the Islamic Conference
OPSEC	Operations Security
PMESII-PT	Political, Military, Economic, Social, Information, Infrastructure, Physical Environment, and Time
SARS	Severe Acute Respiratory Syndrome
SIGINT	Signal Intelligence
SOF	Special Operations Forces
SSG	Strategic Studies Group
STT	Special Tactics Teams
TACAN	Tactical Air Navigation System
TSOC	Theater Special Operations Command
U.S.	United States
UIM	Urban Intervention Model
UN	United Nations
USAID	United States Agency for International Development
USSOCOM	United States Special Operations Command
WFP	World Food Programme
WHO	World Health Organization

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I. INTRODUCTION

A. BACKGROUND

Increased urban migration and rapid population growth have resulted in more people living in cities than in rural areas for the first time in human history.[1] This mass flow of people to urban centers has produced megacities, which are commonly defined as cities with 10 million or more residents.[2] As of 2016, 12% of the world's population lives in 36 megacities and that number will continue to rise, especially among developing nations. By 2030, experts estimate that 17 mega regions, hosting 60% of the world's population, will account for 75% of the world's GDP.[3] A mega region is comprised of cities and towns that grew together to form one continuous urban space.[4]

Megacities come with several unique challenges for governance and the provision of services to their populations. First, megacities have dense living conditions, which require continual competition for living space. In developing countries, rapid population growth often produces slums, or areas "where vacant state-owned or private land is occupied illegally."[5] Slums have unclear land ownership, poor quality construction, high rates of crime, and little or no access to services; each of these conditions challenges effective governance.[6] By one estimate, up to one third of all urban dwellers live in slums, in conditions that overwhelm the municipality's ability to care for its inhabitants.[7]

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1. David Kilcullen, "The City as A System: Future Conflict and Urban Resilience," *The Fletcher Forum of World Affairs* 36, no. 2 (Summer 2012), 22.

2. United Nations, *World Urbanization Prospects, The 2014 Revision Methodology*, technical report no. WP.238 (New York, NY: United Nations, 2014), 238.

3. See, Joel Kotkin, *The City: A Global History*, 2005 modern library edition ed. (New York: Modern Library, 2005).

4. See, Richard L. Florida, *The Rise of the Creative Class*, Revisited (New York: Basic Books, 2012).; Joel Kotkin, *The City: A Global History*, Modern Library Edition ed. (New York: Modern Library, 2005).

5. Yerach Doytsher et al., *Rapid Urbanization and Mega Cities: The Need for Spatial Information Management: Research Study*, ed. Chryssy A. Potsiou, FIG Report 48 (Copenhagen, Denmark: International Federation of Surveyors (FIG), 2010), 7.

6. Doytsher et al., Rapid Urbanization and Mega, 20.

7. Doytsher et al., Rapid Urbanization and Mega, 20

Second, megacities often face challenges with providing and managing resources for their populations. Limited access to essential resources such as fresh food and potable water has placed many of the urban poor on the brink of starvation.[8] Increasing traffic has caused widespread pollution, leading to increased levels of respiratory disease, in addition to causing massive traffic jams that literally last for days and hinder the effective distribution of resources and services.[9] Governments also struggle with waste disposal, which has contaminated already strained water supplies.[10] These conditions amplify the spread of infectious disease, which is another concern of megacities.

Third, advances in technology, particularly information technology, have created challenges and opportunities for megacities.[11] Connectedness through social media and the Internet has produced access to information that is rapidly and efficiently shared between residents in large municipalities. The connected nature of the city allows anyone, even those living in slums, to access global networks for the exchange of money and goods, allowing people of all backgrounds to conduct business across borders.[12] However, this connectedness also creates opportunities for criminals or insurgents; illicit actors can more efficiently organize, mobilize support, and often propagate information campaigns beyond the control of local authorities.

Finally, megacities pose unique challenges for military intervention. The sheer number and density of people living in a megacity require greater security forces than are likely available. For example, a 16 to 1,000 force ratio in a megacity with 10 million residents would theoretically require 160,000 security forces to secure the city. This number exceeds the 120,000 American troops deployed for the invasion of Iraq in 2003,

8. "Food Deserts," United States Department of Agriculture, Agricultural Marketing Service, accessed December 4, 2015. http://apps.ams.usda.gov/fooddeserts/ foodDeserts.aspx.

9. Michael Adeloye Adebamowo, "The Implication of Global Economic Recession on Sustainable Housing," International Business Research 4, no. 1 (January 2011): 75.

10. Waste Management World. "Megacities," Last modified January 4, 2012, accessed December 4, 2015. http://waste-management-world.com/a/ talking-heads-megacities, 2.

11. David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla* (Oxford: Oxford University Press, 2013), 33.

12. Kilcullen, *Out of the Mountains*, 32–33; "The Conduct of Future," 12.

which was one of the largest military mobilizations since World War II.[13] It is unlikely that any Western government would be able to field these numbers for stability operations, much less sustain them over a long period of time.

Historical examples of foreign military intervention into large cities have demonstrated the many challenges posed by these operations. For example, United Nations' and United States' intervention in Mogadishu in 1993 showed how a city with weak government and expansive poverty could create the most challenging of environments for some of the best trained and most advanced militaries in the world.[14] Similarly, the 2010 Haitian earthquake that shook Port Au Prince stretched the resources of the entire international community.[15] These problems would only compound in a megacity such as Rio de Janeiro with populations exceeding 10 million inhabitants and currently reaching as high as 38 million inhabitants in Tokyo-Yokohama.

Megacities are a new kind of urban environment where nations have not tested traditional strategies and military force on such a grand scale. Despite this, military doctrine has not yet addressed these emerging environments. Western military leaders and organizations recognize that there are doctrinal gaps in their current understanding of large cities. The Chief of Staff of the Army, for example, convened a strategic studies group on megacities in 2014. The concept team concluded that, "It is inevitable that at some point the United States Army will be asked to operate in a megacity and currently the Army is ill-prepared to do so."[16]

NATO, the U.S. Chief of Staff of the Army, and United States Special Operations Command (USSOCOM) all list megacities among their top research priorities.[17]

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13. Peter J. Krause, Troop Levels in Stability Operations: What We Don't Know (Cambridge, Massachusetts Institute of Technology for International Studies, February 2007, 1.

14. Kilcullen, *Out of the Mountains*, 84.

15. Gary Cecchine, *The U.S. Military Response to the 2010 Haiti Earthquake: Considerations for Army Leaders* (Santa Monica, CA: RAND, 2013), 40.

16. Harris et al., "Megacities and the United States Army," 3, 8.

17. Brian A. Maher, comp., *Special Operations Research Topics 2016* (MacDill Air Force Base, FL: The JSOU Press, 2015); Henrik Sommer, "Calling Notice For The NATO Urbanisation Experiment, 20–25 September 2015 at The Modelling And Simulation Centre of Excellence (M&S COE), Rome," June 25, 2015; Troxell, *2015-16 Key Strategic Issues*, 9:

According to the Key Strategic Issues List (KSIL) created by the Chief of Staff of the U.S. Army,

> Unified land operations within [a] complex urban terrain is fast becoming a reality Army formations must contend with. Army doctrine fails to adequately grasp the complexity of large cities, megacities are not currently a unit of analysis within the Department of Defense intelligence community, and megacities and dense urban terrain are not featured in the defense planning scenarios which shape force composition or employment.[18]

Similarly, the USSOCOM Command KSIL lists megacities among its top four research priorities. The USSOCOM KSIL poses the questions, "Is the megacity environment unique for SOF?," and if so "What capabilities are required for understanding it and conducting the full range of SOF activities?"[19]

B. RESEARCH QUESTION

This thesis attempts to answer the following question: What do Geographic Combatant Commands (GCCs) and Theater Special Operation Commands (TSOCs) need to know about megacities, and how can they improve the planning process to more rapidly assess, synchronize, and guide military operations in megacities?

C. METHODOLOGY

The thesis focuses on megacities and the military planning process for interventions. It begins by using the rich body of literature on megacities and urbanization. From this literature, the thesis provides a summary of common megacity characteristics, trends, and conditions relevant to military planners. The thesis also considers existing military doctrine from across Western militaries, and these doctrines' ability to adequately inform megacity intervention.

From this discussion, this thesis consults various planning and modeling techniques to propose a four-part model—the Urban Intervention Model (UIM)—that allows military leaders to conduct a rapid assessment and plan for military intervention

18. Troxell, *2015-16 Key Strategic Issues*, 9.

19. Maher, *Special Operations Research Topics*, 48.

into a megacity in the wake of natural or manmade disasters. The thesis nests each step of the proposed model with existing doctrine and planning practices, and explains the utility each step of the model has for intervention planning.

The thesis then uses the model to plan for a Theater Special Operations Command (TSOC) level intervention into a fictitious city of 18 million, Cairene, in the aftermath of a devastating earthquake. The TSOC's intervention should address wide-scale human suffering and prevent regional destabilization. The chapter applies each step of the UIM to the problem and identifies key centers of gravity to target. This hypothetical intervention demonstrates how to use the model while incorporating principles from the megacity literature.

D. RECOMMENDATIONS

Following this study of megacities and developing the UIM, this thesis offers three recommendations. First, the U.S and NATO forces should consider designating cities as a new operational domain. Rather than adapting current land warfare doctrine to urban terrain, making megacities an operational domain will allow for the development of more focused urban doctrine and strategy. Second, U.S. and NATO forces should develop inter-service, interagency, and international games and exercises that focus on multilateral intervention into megacities in the wake of natural or manmade disasters. Wargames increase experience and decision making skills, while exercises help identify capability gaps, improve cohesion, and streamline logistics during actual interventions.[20] Third, U.S. military and NATO forces should establish enduring relationships with civilian agencies and experts versed in the vulnerabilities and resiliencies of urban environments prior to interventions. Combining civilian and military expertise reduces capability caps while capitalizing on the strengths of multiple organizations. Pre-coordinated relationships and on-the-ground cooperation may provide for a more rapid and cohesive response in a megacity intervention.

20. Bruce Stanley, "Wargames, Training, and Decision-Making. Increasing the Experience of Army Leaders" (master's thesis, School of Advanced Military Studies United States Army Command and General Staff College, 2000), iii.

E. OUTLINE OF THE THESIS

The thesis proceeds as follows: Chapter II provides an overview of megacities, including offering a working definition of megacities, and unique challenges of governance and resources to megacities. Chapter II then uses this discussion to inform security concerns for military intervention. It details military considerations that highlight Western military's unpreparedness to conduct operations in megacities.

Chapter III begins by describing useful planning and conceptual models for understanding megacities from a military perspective. From this discussion, the chapter presents the UIM, a four-part model, and explains the UIM's steps and sub-steps in detail.

Chapter IV uses the UIM to plan a TSOC-led intervention into a fictitious megacity—Cairene—following an earthquake. It demonstrates how to apply each of the UIM steps within the scenario. The chapter ends with a brief discussion of the wider application of the UIM and operational considerations for military planners.

Chapter V concludes with proposals on how Geographic Combatant Commands (GCCs) and TSOCs can adapt their planning process to account for the complexity in a megacity. It will provide a list of recommendations for future megacity research related to military interventions.

II. WHAT IS A MEGACITY?

Over the last century, accelerating population growth and increased industrialization have shifted human habitat from rural to urban centers, creating what has become known as megacities.[21] Megacities present a number of challenges for governance, resource management, disease control, and crime management. Megacities also pose unique challenges to intervening military forces. According to a U.S. Army Strategic Studies Group, megacities are "blind spots from which strategic surprise could emerge."[22]

This chapter provides an overview of megacities and their unique challenges to security and intervening military forces. It begins with a brief summary of various descriptions of a megacity, providing a working definition that includes both population and density in territory. The chapter then explores trends and problems that affect megacities, highlighting that megacities are complex systems with vulnerabilities that will shape conflicts in the future. Finally, the chapter concludes with a detailed look at the challenges for military intervention in megacities, including existing military doctrine and its perspectives on intervention.

A. WHAT IS A MEGACITY?

Despite growing concern over larger and larger cities and the various challenges they present to governance and resources, there is no consensus on the definition of a megacity. The majority of researchers agree with the UN's definition that a city with 10 million or more inhabitants is a megacity.[23] However, despite this simple definition that relies solely on one variable (population), calculating the sheer number of inhabitants of a megacity is difficult. One method of counting inhabitants requires using existing census

21. United Nations, *World Population Prospects: The 2015 Revision, Key Findings and Advance Tables*, Technical Report No. ESA/P/WP.241, (n.p; United Nations, Department of Economic and Social Affairs, Population Division, 2015), 2.

22. Marc Harris et al., "Megacities and the United States Army: Preparing for a Complex and Uncertain Future," (Arlington: U.S. Military, 2014), 21.

23. United Nations, *World Urbanization Prospects, The 2014 Revision Methodology*, technical report no. WP.238 (New York, NY: United Nations, 2014), 238.

or population registers to identify the number of people living in a city. In this case, the country in which the city resides reports both the city's boundaries and its number of inhabitants. The UN report on megacities, for example, relies on census data from each city to arrive at its list of megacities, which it updates every two years. It notes:

> No attempts have been made to impose consistency in definitions across countries. However, several efforts are underway at different institutions to produce globally comparable estimates of the urban population with uniform criteria to define urban areas based on satellite imagery of land cover or night-time lights.[24]

Another method of measuring the inhabitants of megacities uses satellite imagery. For example, Wendell Cox, a municipal public policy expert, uses the satellite land cover imagery methodology to determine both land area and population in a megacity. Cox's approach, in other words, allows him to calculate urban space regardless of administrative boundaries.[25] For example, Chongqing, China technically has the largest population of any city in the world, but its administrative territory is roughly equivalent to an area close to the size of Austria.[26] By contrast, Dhaka, Bangladesh has 14.6 million residents within 125 square miles making it the most densely populated city in the world. To put this further in perspective, the New York urban area is only 1/20th the density of Dhaka.[27] Cox's annual research report states that, as of January 2015, 34 cities had 10 million or more inhabitants, as opposed to the UN list that has only 28 megacities.[28] Due to the way population estimates are gathered, there is a debate over the 20% discrepancy between the UN and Demographia.[29] See Tables 1 and 2 for demographia and United Nations data.

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24. United Nations Department of Economic and Social Affairs/Population Division, *World Urbanization Prospects: The 2014 Revision, Methodology,* 3.

25. Wendell Cox, *Demographia World Urban Areas, 11th Annual Edition*, Demographia World Urban Areas 2015:01 (Belleville, IL: Wendell Cox Consultancy, 2015): accessed January 15, 2016, http://www.demographia.com/db-worldua.pdf, 7.

26. Cox, "Demographia World Urban Areas," 6.

27. Wendell Cox, "Evolving Urban Form: Dhaka," New Geography, last modified August 8, 2012, accessed January 27, 2016, http://www.newgeography.com/content/003004-evolving-urban-form-dhaka.

28. Cox, "Demographia World Urban Areas." 7.

29. Cox, "Demographia World Urban Areas," 7.

Table 1. Demographia 2015 Megacities[30]

Rank 2015	Country	Urban Area	Population	Density
1	Japan	Tokyo-Yokohama	37,843,000	4,400
2	Indonesia	Jakarta	30,539,000	9,500
3	India	Delhi, DL-UP-HR	24,998,000	12,100
4	Philippines	Manila	24,123,000	15,300
5	South Korea	Seoul-Incheon	23,480,000	10,400
6	China	Shanghai, SHG-JS-ZJ	23,416,000	6,100
7	Pakistan	Karachi	22,123,000	23,400
8	China	Beijing, BJ	21,009,000	5,500
9	United States	New York, NY-NJ-CT	20,630,000	1,800
10	China	Guangzhou-Foshan, GD	20,597,000	6,000
11	Brazil	Sao Paulo	20,365,000	7,500
12	Mexico	Mexico City	20,063,000	9,700
13	India	Mumbai, MH	17,712,000	32,400
14	Japan	Osaka-Kobe-Kyoto	17,444,000	5,400
15	Russia	Moscow	16,170,000	3,500
16	Bangladesh	Dhaka	15,669,000	43,500
17	Egypt	Cairo	15,600,000	8,900
18	United States	Los Angeles, CA	15,058,000	2,400
19	Thailand	Bangkok	14,998,000	5,800
20	India	Kolkata, WB	14,667,000	12,200
21	Argentina	Buenos Aires	14,122,000	5,300
22	Iran	Tehran	13,532,000	9,100
23	Turkey	Istanbul	13,287,000	9,800
24	Nigeria	Lagos	13,123,000	14,500
25	China	Shenzhen, GD	12,084,000	6,900
26	Brazil	Rio de Janeiro	11,727,000	5,800
27	Congo (Dem. Rep.)	Kinshasa	11,587,000	19,900
28	China	Tianjin	10,920,000	5,400
29	France	Paris	10,858,000	3,800
30	Peru	Lima	10,750,000	11,700
31	China	Chengdu, SC	10,376,000	6,700
32	United Kingdom	London	10,236,000	5,900
33	Japan	Nagoya	10,177,000	2,600
34	Pakistan	Lahore	10,052,000	12,700

30. Adapted from: Cox, "Demographia World Urban Areas."

Table 2. United Nations 2014 Megacities[31]

Rank 2014	Country	Urban Agglomeration	2014
1	Japan	Tokyo	37,833,000
2	India	Delhi	24,953,000
3	China	Shanghai	22,991,000
4	Mexico	Ciudad de México (Mexico City)	20,843,000
5	Brazil	São Paulo	20,831,000
6	India	Mumbai (Bombay)	20,741,000
7	Japan	Kinki M.M.A. (Osaka)	20,123,000
8	China	Beijing	19,520,000
9	United States of America	New York-Newark	18,591,000
10	Egypt	Al-Qahirah (Cairo)	18,419,000
11	Bangladesh	Dhaka	16,982,000
12	Pakistan	Karachi	16,126,000
13	Argentina	Buenos Aires	15,024,000
14	India	Kolkata (Calcutta)	14,766,000
15	Turkey	Istanbul	13,954,000
16	China	Chongqing	12,916,000
17	Brazil	Rio de Janeiro	12,825,000
18	Philippines	Manila	12,764,000
19	Nigeria	Lagos	12,614,000
20	United States of America	Los Angeles-Long Beach-Santa Ana	12,308,000
21	Russian Federation	Moskva (Moscow)	12,063,000
22	China	Guangzhou, Guangdong	11,843,000
23	Democratic Republic of the Congo	Kinshasa	11,116,000
24	China	Tianjin	10,860,000
25	France	Paris	10,764,000
26	China	Shenzhen	10,680,000
27	United Kingdom	London	10,189,000
28	Indonesia	Jakarta	10,176,000

In addition to measuring population density, satellite imagery can also measure economic activity over a large contiguous urban area that may include multiple cities and metropolitan areas. Timothy Gulden, a researcher at the University of Maryland's Center for International and Security Studies, uses night-time lights to estimate the amount of economic activity in urban areas, what he calls light-based regional product (LRP).[32] LRP data is best used to measure economic activity across a large contiguous urban region

31. Adapted from: United Nations, *World Population Prospects: The 2015 Revision, Key Findings and Advance Tables*, Technical Report No. ESA/P/WP.241, (n.p; United Nations, Department of Economic and Social Affairs, Population Division, 2015)

32. Richard L. Florida, *Who's Your City?: How the Creative Economy Is Making Where to Live the Most Important Decision of Your Life* (New York: Basic Books, 2008), 22.

with populations ranging from five to 100 million inhabitants.[33] This method is able to generate globally comparable economic vitality between city regions, but it comes with challenges, namely delineating between cities and sprawling populations that cover several cities. While Gulden's approach has been successful in showing the economic vitality of a region, it has not yet included population data, nor has it been applied to define a megacity alone.

Another approach to defining megacities comes from the Chief of Staff of the U.S. Army, who convened a Strategic Studies Group on Megacities. The group's emphasizes the following criteria: context, scale, density, connectedness, flow and threats as criteria for understanding the qualitative nature of a megacity.[34] It argues that a useful typology for categorizing cities is revealed when these criteria are considered alongside drivers of instability and a government's ability to meet demands for services and security amid rising insecurity and strained capacity. The report further states, "one of the hallmarks of megacities is rapid hetero and homogeneous population growth that outstrips city governance capability."[35]

Building on these points, current megacities exist in both the developed and developing world, but current trends suggest that the number and size of megacities will grow in the developing world.[36] Furthermore, megacities in developing countries tend to outpace their ability to build adequate infrastructure and meet their populations' demands. Therefore, it is helpful to consider developed and developing megacities separately. The report goes on to note that the level of dysfunction among megacities in the developing world is greater than that in the developed world due to an overwhelming

33. Florida, *Who's Your City?: How the Creative*, 41.

34. Mark Lomedico and Elizabeth M. Bartels, "City As a System Analytical Framework: A Structured Analytical Approach to Understanding and Acting in Urban Environments," *Small Wars Journal*, August 4, 2015: accessed January 15, 2016, http://smallwarsjournal.com/jrnl/art/city-as-a-system-analytical-framework-a-structured-analytical-approach-to-understanding-and, 10.

35. Harris et al., "Megacities and the United States Army," 12.

36. Harris et al., "Megacities and the United States Army," 4.

lack of integration of the public, private, and commercial sectors, which makes them vulnerable to a variety of security concerns.[37]

In sum, regardless of the method used to measure population, megacities are universally defined in terms of numerical population data, with the current number at 10 million or more. However, defining a megacity based on this single factor fails to capture the dynamics that make such high numbers significant. Furthermore, such heavy emphasis on a numerically-based definition implies that all megacities are the same once they reach a certain population threshold. Megacities, like all cities, should be understood as multiple complex systems that support an urban population within a bounded space.

B. PROBLEMS AND TRENDS THAT AFFECT MEGACITIES

In addition to creating a working definition of a megacity, it is also important to identify key trends that affect megacities. An important consideration in the emergence of megacities is what military strategist and counter insurgency expert David Kilcullen calls "conflict climate."[38] Kilcullen specifically describes three megatrends that affect the conflict climate for urban environments: population growth and urbanization, littoralization, and connectedness.[39] Population growth and urbanization will result in a world urban population of over six billion by 2050, with the majority living in the world's poorest areas. According to Kilcullen this will be, "a recipe for conflict, for crises in health, education, and governance, and for food, energy, and water scarcity."[40] Kilcullen describes littoralization as the tendency for people to cluster on coastlines and bodies of water. He notes, that as of 2012, 80% of the world's population lived within fifty miles of the ocean. Megacities are no exception with 84% of the world's megacities being situated on a coast or major river delta at the turn of the century.[41] These areas will

37. Harris et al., "Megacities and the United States Army," 12–14.

38. David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla* (Oxford: Oxford University Press, 2013), 27–28, 240.

39. Kilcullen, *Out of the Mountains*, 30

40. Kilcullen, *Out of the Mountains*, 29

41. Kilcullen, *Out of the Mountains*, 30.

be key terrain in future conflicts as "an increasing proportion of the world's population, economic activity and military capability will be centered in the coastal cities."[42]

Additionally, Kilcullen notes the importance of "connectedness" in megacities. Connectedness means that access to services and information is rapidly and efficiently shared between residents in large municipalities. The connected nature of the city allows anyone to tap global networks for the exchange of money and to conduct business across borders.[43] Propagation of technology in the developing world since 2000 has ensured that slums, businesses, and governments alike will remain connected to their networks of associates, friends, and family. While increased use of technologies facilitate connectedness and may have benefits to governments, it also creates opportunities for criminal or insurgents to more efficiently organize and propagate information campaigns to garner public support for illicit activities.[44] Kilcullen further contends that the three megatrends will be predominant in the "Global South," a term synonymous with the developing world.[45]

Another report that notes future trends and challenges with megacities comes from the U.S. National Intelligence Council (NIC). In 2012, the NIC published "Global Trends 2030: Alternative Worlds."[46] The report identifies four critical "megatrends" likely to occur (individual empowerment, diffusion of power, demographic patterns, and food, water, energy nexus, see Appendix A), six critical factors, or "game changers" (crises-prone global economy, governance gap, increased conflict, wider scoped regional instability, new technological impacts, and the role of the United States, see Appendix A), that will influence future realities, and six "tectonic shifts" that are likely to occur (growth of the middle class, wider access to lethal and disruptive technologies, definitive shift of economic power to the East and South, unprecedented and widespread aging,

42. David J. Kilcullen, "The Conduct of Future Operations in the Urban Littoral, and its Implications for NATO" (unpublished, 2015), 12.

43. Kilcullen, *Out of the Mountains*, 32–33; "The Conduct of Future Operations," 12.

44. Kilcullen, *The Conduct of Future Operations*, 19.

45. Kilcullen, *The Conduct of Future Operations*, 1.

46. *Global Trends 2030: Alternative Worlds: a Publication of the National Intelligence Council* (December 2012; National Intelligence Council, 2012).

urbanization, and food and water pressures, see Appendix A).[47] The four critical megatrends conclude that megacities may become limited by physical land constraints, vehicular congestion, costly infrastructure, deteriorating sanitation, increased criminal networks, and political gridlock.[48] Furthermore, the six "tectonic shifts" will all have implications for megacities in the future. For example, competition for fresh water and land will increase tensions over water rights, water quality, and territorial expansion. The tensions will manifest legal actions, civic demand for state intervention, and policy reform.[49]

The NIC report states that smart cities, or "urban environments that leverage information-technology-based solutions to maximize economic productivity and quality of life while maximizing resource consumption and environmental degradation," are emerging as a key characteristic of the most advanced megacities, like New York and London.[50] In order to create the systems required to govern megacities with smart technology, investments in infrastructure are needed. The enormous scale, complexity and costs of implementing new technologies to create smart cities are not likely without the appropriate flow of income to municipal governments. Furthermore, the report posits that heavy investment in smart-city infrastructure in urban centers of Africa, Latin America, and Asia will lead to the epicenter of smart-city innovation moving, away from Europe and North America by 2030.[51] Finally, the report hypothesizes that, when smart city technology is implemented, it will form the foundation for city planning and disaster and emergency response.[52]

Another vulnerability facing megacities comes from their slums. Up to one third of all urban dwellers, live in slums that have exceeded the municipality's ability to care

47. National Intelligence Council, *Global Trends 2030: Alternative*, ii.
48. National Intelligence Council, *Global Trends 2030: Alternative*, 29.
49. National Intelligence Council, *Global Trends 2030: Alternative*, 29.
50. National Intelligence Council, *Global Trends 2030: Alternative*, 89.
51. National Intelligence Council, *Global Trends 2030: Alternative*, 90.
52. National Intelligence Council, *Global Trends 2030: Alternative*, 89.

for its inhabitants.[53] The International Federation of Surveyors (FIG), a UN-recognized organization, points to how slums will affect megacities in its report, "Rapid Urbanization and Mega Cities: The Need for Spatial Information Management."[54] The report defines slums or informal settlements as the locations "where vacant state-owned or private land is occupied illegally and is used for illegal slum housing."[55] Because of this, governments have provided little or no services.[56] Slums have unclear land ownership, poor quality construction, high rates of crime, little or no access to services, and are in violation of land-use zoning.[57] The report further notes that, in 2010, 70% of urban population growth occurred outside of formal planning and 30% of developing nations' urban population lived in slums or settlements where land is occupied illegally.[58] Alongside these statistics, 90% of new settlements in Sub-Saharan Africa, in particular, qualify as slums.[59] Currently one billion people live in slums, and by 2020 the number will likely grow to 1.4 billion.[60]

Another challenge in megacities is "feralization." Feralization is the process by which poor, informal areas, including slums, become 'wild' and insubordinate to formal governance.[61] According to Kees Koonings and Dirk Kruijt, professors of Development Studies at Utrech University, feralization results in "urban excluded" who rely upon

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53. Richard Carter, "Megacities Present Global Health Hurdle: Experts," *Phys.Org*., accessed December 4, 2015, http://phys.org/news/ 2010–10-megacities-global-health-hurdle-experts.html.

54. Yerach Doytsher et al., *Rapid Urbanization and Mega Cities: The Need for Spatial Information Management: Research Study*, ed. Chryssy A. Potsiou, FIG Report 48 (Copenhagen, Denmark: International Federation of Surveyors (FIG), 2010).

55. Doytsher et al., *Rapid Urbanization and Mega*, 7.

56 Doytsher et al., Rapid Urbanization and Mega, 19.

57. Doytsher et al., *Rapid Urbanization and Mega*, 20.

58. Doytsher et al., *Rapid Urbanization and Mega*, 7.

59. Doytsher et al., *Rapid Urbanization and Mega*, 7–8.

60. Doytsher et al., *Rapid Urbanization and Mega*, 20; Nadaa Taiyab, *Transportation in Mega-Cities: A Local Issue, A Global Question*, The Fredrick S. Pardee Center for the Study of the Longer-Range Future (n.p., 2008), 7.

61. Kilcullen, *Out of the Mountains*, 68–69, 237; Richard J. Norton, "Feral Cities," *Naval War College Review* 66, no. 4 (Fall 2003): 101, 103; Alon Paz. "Rise of the Feral Adversary," War on the Rocks. Last modified November 13, 2014, accessed September 2, 2015, http://warontherocks.com/2014/11/the-rise-of-the-feral-adversary/.

informal systems to fulfill the needs that are not met by governments.[62] These systems take the form of black markets, gangs, and other illicit institutions. The services provided by these informal systems may range from criminal to civic service; however, the key distinction is that governments are not providing these services, so informal or extra-governmental entities fill the void.[63] Formal structures are forced to confront this 'parallel' informal structure in what Koonings and Kruijt describe as low intensity conflict. The authors state, "In many cases the local state is drawn into a perverse spiral of escalating violence, crime and arbitrary conduct that is transforming the cityscape into a theatre of low intensity warfare."[64] Formal governments often resort to repressive means while attempting to regain control in these feral areas. Repression in turn furthers spatial segregation, stigmatization and violence, all of which deepen mistrust between the population and the government.[65] These areas become the center of a contentious and often violent struggle for control between competing systems of governance.[66]

Yet another growing trend in megacities is their interconnectedness, which is both an opportunity and a vulnerability. An example of this interconnected vulnerability comes from the 2008 global financial crisis. University of Lagos engineer Michael Adebawomo describes how the crisis, which originated in the United States, triggered negative effects for the economic wellbeing of businesses in Lagos, Nigeria:

> Businesses across all sectors suffer a serious decline in sales turnover and their profits shrink, borrowers default on repayment of loans, banking system breaks down, prices of food, fuel and other essential commodities shoot up, value of houses drops, and companies offer voluntary retirement programs to reduce their workforce and cut down wages.[67]

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62. Koonings and Kruijt, *Megacities: The Politics of Urban*, 3–5.

63. Koonings and Kruijt, *Megacities: The Politics of Urban*, 2. David Shunk, "Mega Cities, Ungoverned Areas, and The Challenge of Urban Combat Operations 2030–2040," *Small Wars Journal*, January 23, 2014, 8.

64. Koonings and Kruijt, *Megacities: The Politics of Urban*, 2.

65. Koonings and Kruijt, *Megacities: The Politics of Urban*, 4.

66. Koonings and Kruijt, *Megacities: The Politics of Urban*, 20.

67. Michael Adeloye Adebamowo, "The Implication of Global Economic Recession on Sustainable Housing," *International Business Research* 4, no. 1 (January 2011): 167–75.

Fiscal policies established abroad now have broad tangible effects in foreign economies and specific effects in megacities that are directly tied to the foreign corporations that operate in them. When foreign economies are healthy wealth can flow freely into megacity economies, but severe economic decline can have disproportionate effects.

Another challenge in megacities is resource scarcity. Some examples of resource scarcity include reduced access to essential resources necessary for consumption or the limited ability to effectively dispose of waste; these limits can rapidly overwhelm a city's physical infrastructure. For instance, according to the Community Health Councils Food Development Working Group, Los Angeles contains vast areas where its residents experience inadequate access to fresh food.[68] These "food deserts," which contribute to diabetes and heart disease, are defined as an urban location greater than one mile away from adequate food markets.[69] Delhi, India provides a useful example of how reduced access to potable water has triggered new problems for its citizens and government. The sustainable carrying capacity for Delhi's water infrastructure is estimated to be 7.8 million people. 2015 estimates claim that the country is approaching water depletion with a population of 24.9 million and a water consumption demand of 14.1 billion liters/day. As a result, bathing and commercial use of water is limited. Furthermore, due to the high demand for water, a black market has emerged that the city government is unable to stop.[70] This dynamic shows the challenges of megacities in managing finite and critical resources.

Management of waste is another critical challenge that plagues many megacities. Physicist and environmental activist Soni Vikram notes in a study that waste management is consistently among the top five concerns for city mayors worldwide.[71] Currently the world's cities produce 1.3 billion tons of municipal solid waste (MSW) per year, and if

68. Nicky Bassford, Lark Galloway-Gilliam, and Gwendolyn Flynn. "Food Desert to Food Oasis," *Community Health Councils Food Development Working Group*, July 2010, 1.

69. "Food Deserts," United States Department of Agriculture, Agricultural Marketing Service, accessed December 4, 2015. http://apps.ams.usda.gov/fooddeserts/ foodDeserts.aspx

70. Vikram, "Water and Carrying Capacity of a City: Delhi," 4745–4749.

71. Waste Management World. "Megacities," Last modified January 4, 2012, accessed December 4, 2015. http://waste-management-world.com/a/ talking-heads-megacities, 1.

current urbanization trends continue, that number will reach 2.2 billion tons by 2025.[72] Although biological waste may be converted to energy if the appropriate infrastructure is in place, MSW is increasingly non-biological due to greater use of disposable consumer goods, and therefore not easily transformed into energy.[73] Inadequate waste disposal can lead to contamination of water and communities.[74] These conditions, when coupled with poor sanitation and an inadequate healthcare system, can accelerate the spread of infectious diseases like Cholera, SARS or H5N1 bird flu in dense urban areas.

Air pollution is another challenge of megacities. Since the beginning of the industrial age, urban dwellers have struggled with smog, the byproduct of burning wood and fossil fuels. This trend reached its zenith among developed megacities in the mid-20th century, with smog causing an estimated 4,000 deaths per week in London and causing similar problems in Los Angeles.[75] Since that time, government policies have reduced industrial emissions in the developed world. However, air pollution is still considered to be the world's single largest health risk according to the World Health Organization (WHO).[76] The WHO released a statement in 2014 stating that, in 2012, over seven million people died due to the effects of air pollution.[77] Air pollution will continue to be a challenge as populations grow and urbanization rates rise in mega cities.

Automotive traffic and congestion are yet further challenges for megacities. Increased economic affluence has allowed for the proliferation of individual automobile ownership.[78] In addition to the added pollution this causes, traffic congestion is a part of life in the world's megacities. Widespread congestion and traffic jams can literally last

72. Waste Management World, "Megacities," 2012, 2.

73. Waste Management World, "Megacities," 2012, 2.

74. Adebamowo, "The Implication of Global Economic Recession on Sustainable Housing," 75.

75. Bhola R. Gurjar, and Tushar P. Singh. "Air Quality in Megacities," Edited by Howard Hanson. The Encyclopedia of Earth. Last modified September 18, 2014, accessed December 4, 2015, http://www.eoearth.org/view/article/149934/.

76. See, *Burden of Disease from Joint Household and Ambient Air Pollution for 2012*. Technical report no. 2014. Public Health, Social and Environmental Determinants of Health Department 2014. Geneva, Switzerland: World Health Organization, 2014.

77. *Burden of Disease from Ambient Air Pollution for 2012*., 2014.

78. Waste Management World, "Megacities," 2012, 1.

for days in places like Lagos, Nigeria.[79] To reduce congestion, London implemented a plan restricting areas of the city from vehicle traffic or charging a fee for access. Although this plan reduced congestion, emissions were increased because vehicles could travel faster and produced greater emissions than in traffic jams.[80] Mexico City counters their congestion through the implementation of a "no drive day"; however, this scheme has proved difficult to enforce.[81]

The volume and complexity of megacities tests governments' abilities to deliver essential services, provide adequate governance, and enforce security on a daily basis. However, in addition to the present and future challenges mentioned above, providing security—and particularly military intervention to megacities—becomes its own unique challenge.

C. MILITARY CHALLENGES FOR OPERATIONS IN MEGACITIES

Megacities pose unique challenges for militaries tasked to conduct humanitarian assistance, disaster response, low-intensity conflict and high-intensity operations. For over two decades, numerous academics and military practitioners have called for new urban warfare strategies and capabilities designed to prepare for and meet these challenges.[82] For example, Kenneth Hewitt, a geographic and environmental expert, observed in 1983, "urban places and their geography, in particular, are deeply embroiled

79. Adebamowo, "The Implication of Global Economic Recession on Sustainable Housing," 75.

80. Gurjar et al., "Air Quality in Megacities," 2014.

81. Gurjar et al., "Air Quality in Megacities," 2014.

82. Arjun Appadurai, "Modernity At Large: Cultural Dimensions of Globalization*,"* (Minneapolis, Minn; University of Minnesota Press, 1996),152; Defense Intelligence Reference Document (DIRC). *The Urban Century: Developing World Urban Trends and Possible Factors Affecting Military Operations (Marine Corps Intelligence Agency, Quantico, 1997), 11;* Phillip Misselwitz, and Eyal Weizmann, "Military Operations as urban planning," Mute, August 28, 2003, accessed November 29, 2015, http://www.metamute.org/editorial/articles/military-operations-urban-planning; Allice Hills, *Future War in Cities: Rethinking a Liberal Dilemma* (London: Frank Cass, 2004), 4–16; Stephen Graham, "*Robo-War TM Dreams: Global South Urbanisation and the U.S. Military's Revolution in Military Affairs,"* No. 20. Working Paper, 2007; David Kilcullen, *Out of the Mountains: The Coming Age of the Urban Guerrilla* (New York: Oxford University Press, [2013]); Alon Paz. "Rise of the Feral Adversary,": Harris et al., "Megacities and the United States Army,"; Paul T. Bartone, Mitchell Armbruster, and National Defense University. Center for Technology and National Security Policy. *Shifting Human Environment: How Trends in Human Geography Will Shape Future Military Operations* ([Washington, D.C.?]: Center for Technology and National Security Policy, National Defense University, [2015]).

in preparations for and consequences of war. There is even reciprocity between war and cities."[83] Michael Evans, a military and security expert, observed in 2007 that "war and cities appear to be redefining themselves in terms of space, scale, time, mobility, and power because of globalization and the diffusion of technology."[84] These trends foreshadow the centrality of urban conflict in the future, especially in littoral regions.[85]

The U.S. and other militaries have already found themselves engaging in urban combat. Randy Gangle, a security and urban warfighting expert states that, between 1982 and 2002, U.S. military forces were involved in 26 conflicts; 21 included urban fighting and 10 were exclusively urban, including Beirut, Panama City, Mogadishu, Port Au Prince, and Grenada and Balkans. Post 9/11 interventions, like Baghdad and Fallujah in Iraq and Kandahar in Afghanistan, confirmed the reality that western militaries will continue to engage in urban combat, including in megacities.

Academics and practitioners describe several unique challenges that megacities create for intervening forces. For example, conflict and security researcher Alice Hills notes that cities are a "complex multidimensional blend of horizontal, vertical, interior and external forms, super imposed on natural relief. Ground maneuver becomes multidimensional."[86] Hills further notes that democracies have tried to avoid armed urban hostilities due to the nature of attrition. She contends that in an increasingly urbanized world, this objective will be less feasible than in the past and that strategists need to reconcile the emerging realities of urban combat with casualty risk aversion.[87]

Military operations in megacities also challenge Western reliance on technology. Stephen Graham, a city and urban life security researcher, notes that urban warfare "undermines the United States' expensively assembled and hegemonic advantages in

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83. Kenneth Hewitt, "Place Annihilation: Area Bombing and the Fate of Urban Places," *Annals of the Association of American Geographers* 73, no. 2 (1983): 258.

84. Michael Evans and Australian Defence College. *City Without Joy: Urban Military Operations Into the 21st Century* (Canberra, ACT: Australian Defence College, 2007), 14.

85. Kilcullen, *The Conduct of Future*, 15.

86. Alice Hills. *Future War in Cities: Rethinking a Liberal Dilemma*. London: Frank Cass, 2004. 9.

87. Hills, "Future War in Cities," 4–16.

surveillance, targeting and killing through precise air- and space-based weapon systems."[88] In other words, Western militaries' ability to surveil and target from the air is severely limited in dense megacities. Hills argues that technological innovations tend to undermine advanced technological superiority because opponents hide among the urban population and maintain anonymity.[89] Hills further notes that historic examples have shown that militaries involved in intense urban confrontations failed to uphold the rules of engagements aimed to protect the population.[90] Therefore, Hills asserts that fighting in an urban environment requires highly trained forces with strong morals and ethics, not greater technology.[91]

The U.S. military has written several publications and field manuals devoted to urban operations. The overarching inter-service manual, Joint Publication (JP) 3-06, defines joint urban operations as "joint operations planned and conducted on, or against objectives within, a topographical complex and its adjacent natural terrain, where man-made construction or the density of population are the dominant features."[92] It recognizes urban operations as a subcomponent of larger land operations.[93] Urban characteristics and conditions, such as complex man-made physical terrain, dense human population, and the presence of life sustaining infrastructure, are underscored while there is little emphasis on the people and systems that make up a city.[94] Although urban topographical features and population density dominate the text and its interpretation of what is important within an urban environment, this is to an extent a reflection of the joint publication's role in synchronizing the joint functions of command and control, intelligence, fires, movement and maneuver, protection and sustainment in an urban

88. Stephen Graham, "Robo-War TM Dreams: Global South Urbanization and the U.S. Military's Revolution in Military Affairs," No. 20. Working Paper, 2007, 4.

89. Hills, "Future War in Cities," 4–16.

90. Hills examined the employment of British Forces in Northern Ireland and Basra, of U.S. Forces in Baghdad, French Forces in Algiers, Israeli Forces in Jenin and Russian Forces in Grozny.

91. Hills, "Future War in Cities," 56–58, 82–84.

92. *Joint Urban Operations*, vii.

93. See, *Joint Urban Operations*. Joint Publication no. 3-06. Washington, DC: Joint Chiefs of Staff, 2013.

94. *Joint Urban Operations*, v.

environment.[95] Rather than outlining a comprehensive approach to urban combat, the intent of JP 3-06 is to provide a framework for managing and deconflicting joint operations.

In addition to joint doctrine, individual U.S. services have their own urban doctrinal publications. One example is the Army's Field Manual (FM) 3-06, *Urban Operations*.[96] The purpose of this manual is to provide forces with the tools to evaluate an urban environment and its potential effects on military operations, including how to apply the doctrinal principles of Unified Land Operations found in Army Doctrinal Reference Publication (ADRP) 3–0, *Unified Land Operations*.[97] FM 3-06 provides a historical context of urban operations, noting operations in Beirut and Mogadishu, while stressing the need to understand the urban adversary as adaptive and asymmetric.[98]

As of 2016, NATO lacks doctrine for urban operations. However, to fill this gap, NATO established an Urban Operations Working Group in 2011 with the aim of developing a cohesive Allied Tactical Publication (ATP), that will standardize urban doctrine across the NATO alliance. Once complete, this doctrine will provide the basis for tactical training events and future urban response.[99]

Neither U.S. doctrine nor NATO specifically address urban operations within the context of a megacity and the unique problems posed by population density, slums, and urban sprawl. Rather than viewing the city as a unique operating environment, urban warfare remains a component of traditional land warfare techniques. Specifically, both JP 3-06 and FM 3-06 propose two conventional means of conducting operations in or around large cities: encircle and thus isolate a city; and, second, secure the outskirts of the city and then maneuver to its center with the aim of controlling the city.[100] Within

95. *Joint Urban Operations*, I-2.

96. United States Army, *Urban Operations*, Field Manual no. 3-06 (Washington, DC: Headquarters, Department of the Army, 2012).

97. See, United States Army, *Unified Land Operations*, Army Doctrine Reference Publication no. 3–0 (Washington, DC: Headquarters, Department of The Army, 2012).

98. United States Army, *Urban Operations*, 3–1.

99. Staggs, "NATO Urban Operations Working," Atterbury Muscatatuck.

100 United States Army, Urban Operations, par 6–31, par 7–27 to 7–33.

both of these conventional strategies, the goal is to counter an opposing force through short-term conventional combat operations. These approaches are unlikely to succeed when confronted with the sheer population size and challenges that intervention in a megacity pose.

The Australian Department of Defense drafted a whitepaper in 2014 that aimed to address some of the unique challenges of military operations in megacities.[101] The Directorate of Future Land Warfare paper titled "The Australian Army in the Urban, Networked Littoral." challenges the current doctrinal view that cities are "static, like landscape" and proposes instead that the military should think of them as "living systems that change continuously."[102] The whitepaper further advocates viewing cities as "complex flow systems—of people, money, information, goods, construction materials, food, water, fuel and energy—overlaid on a physical framework that shapes flows and, over time, is shaped by them."[103] The whitepaper also notes that the scale of littoral megacities is "too vast for expeditionary forces to achieve the troop densities recommended in current doctrine."[104]

Building on this observation, perhaps one of the most critical challenges for military intervention in megacities is massing the sheer number of troops required to conduct operations in a dense environment with limited space. The most contemporary and widely accepted method to determine required troop numbers, especially for counterinsurgency, stability and civil support operations, is built on the force to population density ratio.[105] Since 2006, U.S. Army plans have been predicated on the assumption of operating with 20 to 25 security forces per 1,000 members of the

101. Directorate of Future Land Warfare, Department of Defence, David Kilcullen, *The Australian Army in the Urban, Networked Littoral* (Russell Defence Offices, A.C.T; Directorate of Future Land Warfare, 2014).

102. Directorate of Future Land Warfare, Department of Defence, *The Australian Army in the Urban*, 31.

103. Directorate of Future Land Warfare, Department of Defence, *The Australian Army in the Urban*, 31.

104. Directorate of Future Land Warfare, Department of Defence, *The Australian Army in the Urban*, 26.

105. Peter J. Krause, Troop Levels in Stability Operations: What We Don't Know (Cambridge, Massachusetts Institute of Technology for International Studies, February 2007, 2–3.

population, based on a model designed by RAND analyst James Quinlivan.[106] In contrast, military expert John McGrath promotes a lower troop density of 13 security forces per 1,000 members of the population.[107] Other defense experts, such as Steve Goode, argue for a ratio of 11 to 1,000.[108] The Institute for Defense Analysis advocates that a force ratio of 16 to1,000 results in a 50% chance of success, while a ratio of 40 to 1,000 produces a 75% chance of success.[109] See Tables 3 and 4 for force ratios.

Table 3. Force Ratio and Security Force Size for Urban Populations up to 5 Million[110]

	Force Ratio	100,000	500, 000	1 Million	5 Million
Goode	11: 1,000	1,100	5,500	11,000	55,000
McGrath	13: 1,000	1,300	6,500	13,000	65,000
IDA 50%	16: 1,000	1,600	8,000	16,000	80,000
U.S. Army (2006-Present)	20: 1,000	2,000	10,000	20,000	100,000
IDA 75%	40: 1,000	4,000	20,000	40,000	200,000

Table 4. Force Ratio for Megacities[111]

	Force Ratio	10 Million	15 Million	20 Million	30 Million
Goode	11: 1,000	110,000	165,000	220,000	330,000
McGrath	13: 1,000	130,000	195,000	260,000	390,000
IDA 50%	16: 1,000	160,000	240,000	320,000	480,000
U.S. Army (2006-Present)	20: 1,000	200,000	300,000	400,000	600,000
IDA 75%	40: 1,000	400,000	600,000	800,000	1,200,000

106. United States Army. *Field Manual 3–24: Counterinsurgency.* (Washington, D.C; Department of the Army, December 2006), 1–13.

107. John J. McGrath, *Both on the Ground: Troop Density in Contingency Operations* (Fort Leavenworth, KS: Combat Studies Institute Press, 2006), 106.

108. Steve M. Goode, "A Historical Basis for Force Requirements in Counterinsurgency," *Parameters* (Winter 2009–10), 54.

109. Royce R. Kneece Jr.*, et.al., Force Sizing for Stability Operations,* IDA Paper P-4556, (March 2010), accessed on November 11, 2015, http://dodreports.com/pdf/ada520942.pdf

110. Adapted from: Goode, "A Historical Basisis for Force Requirements" 54.; Royce R. Kneece Jr., Force Sizing for Stability Operations.; McGrath, *Both on the Ground*, 106.; United States Army. *Field Manual 3–24: Counterinsurgency,* 1-13.

111. Adapted from: Goode, "A Historical Basisis for Force Requirements" 54.; Royce R. Kneece Jr., Force Sizing for Stability Operations.; McGrath, *Both on the Ground*, 106.; United States Army. *Field Manual 3–24: Counterinsurgency,* 1-13.

Following these assumptions, an intervention with a 16 to 1,000 force ratio in a megacity with 10 million residents would require 160,000 security forces to guarantee a 50% chance of success. This number is approximately 29% higher than the 120,000 American troops originally deployed for the invasion of Iraq in 2003, which was one of the largest military mobilizations since World War II.[112] An increase to a 75% chance of success would have required 400,000 troops.

However, as the above ratios demonstrate, the sheer number of troops required to conventionally occupy a city is politically, and in some cases, logistically impossible. Furthermore, these ratios only address troop strength and do not account for associated considerations such as the time and resources required to mobilize, deploy, and mass an appropriately sized force. How militaries choose to infiltrate a megacity will also present unique challenges. Metropolitan areas, where cities merge together can hamper the insertion of forces due to the lack of large open spaces to mass troops. Restricted terrain for entry and staging areas make intervening forces predictable to the adversary. This predictability increases risk to forces regardless of insertion by land, sea or air.[113] For these reasons, interventions in megacities will require new approaches to compensate for the lack of troops and available time.

As previously mentioned, the feralization trend is another concern for intervening militaries. The feral environment produces feral adversaries that operate out of densely populated areas and use the population as a human shield.[114] Western militaries are compelled to employ conventional tactics, which were not designed for the urban environment and may have a negative impact on the population.[115] Paz asserts that the relationship between these adversaries and the population has fundamentally changed. In the past, insurgents needed support in terms of "guns, money and people" from the local

112. Krause, *Troop Levels in Stability Operations*, 1.

113. ATC Urbanization Project, "Climate and Geographical Implications for Future Urban Operations," Project 75_01_31 (New Concept 1), 31.

114. Paz, "Rise of the Feral Adversary."

115. Paz, "Rise of the Feral Adversary."

population.[116] Through "glocalization," a combination of local and global, "feral" actors have a sphere of control that goes far beyond the boundaries of a city. Increasingly, insurgencies have access to global funding, recruiting and technology in megacities. In the extreme case, Paz argues that this could create a dynamic where "the insurgent is the captor, and the population is the hostage."[117]

Furthermore, Paz argues that Western nations are disadvantaged in combating urban insurgencies, particularly in their ability to react to rapidly changing situations. Their strategies and tactics are driven by technology and not by the assessment of the threat. By contrast, insurgencies form the strategy and tactics around their political end-state. They are highly flexible and can easily and quickly adapt. Furthermore, they leverage their efforts through extensive use of the media by promoting their ideas and undermining the legitimacy of their opponents.[118]

As megacities increasingly become more prominent, they will continue to challenge military capacity and capability to intervene. Keith Dickson summarizes the urban military environment in the following way: "For Western military forces, asymmetric warfare in urban areas will be the greatest challenges of this century […] The City will be the strategic high ground—whoever controls it will dictate the course of future events in the world."[119] Megacities are uncertain environments that challenge Western military's ability to conduct effective operations given currently accepted force ratios, technological gaps, doctrinal shortcomings, and the absence of existing public policies for megacity intervention. Furthermore, military forces will most likely be required to perform across the spectrum of military operations while intervening in

116. Gordon McCormick. "A Pocket Guide to Internal War," Department of Defense Analysis, Naval Postgraduate School, 1994.

117. Paz, "Rise of the Feral Adversary."

118. Paz, "Rise of the Feral Adversary."

119. Dickson, Keith. "The War on Terror: Cities as the Strategic High Ground," (2002) https://scholar.google.com/scholar?hl=en&q=The+war+on+terror%2C+cities+as+the+strategic+high+ground&btnG=&as_sdt=1%2C5&as_sdtp

megacities. The simultaneity of these operations requires a high degree of adaptability and situational awareness.[120]

D. CONCLUSION

This chapter began by providing an overview of what constitutes a megacity, noting the importance of moving beyond just population to include density and urban boundaries. The chapter then highlighted problems and trends that affect megacities, including population growth and urbanization, littoralization, connectedness, slums, and challenges to governance. The final section introduced challenges to intervening forces in megacities, noting the significance of scale with respect to force ratios, and doctrinal considerations for interpreting the operational environment.

The next chapter will examine currently existing and emerging military analytical frameworks that apply to megacities. It will also introduce the Urban Intervention Model (UIM), a planning framework suited to the complexity of megacities. This framework assists planners with analyzing problems that face megacities and organizing urban interventions.

120. Paz, "Rise of the Feral Adversary,"

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III. URBAN INTERVENTION MODEL

Chapter II presented an overview of megacities and their unique characteristics. Chapter II noted, in particular, that megacities in developing countries struggle with resource management, disease control, and crime management problems, along with slums and ambiguous land boundaries, which provide daily challenges for effective governance. These factors make military intervention in megacities difficult particularly because they are not static terrain but rather "living systems that change continuously."[121] Chapter II also noted that the tactics outlined in *Joint Urban Operations* (JP 3-06) do not adequately address these various challenges;[122] new doctrinal considerations are necessary for assessing the operational environment.[123]

Chapter III uses key concepts in military planning and evaluation—Operational Art and Design, the Joint Operation Planning Process (JOPP), and case-based reasoning (CBR)— along with principles from conceptual modeling, including the analytical hierarchy process (AHP), to build an easy-to-use model for military intervention in megacities, the Urban Intervention Model (UIM). This model informs staffs responsible for planning and executing megacity interventions in Geographic Combatant Commands (GCC) and Theater Special Operations Commands (TSOC).

A. OPERATIONAL PLANNING PROCESS AND MEASURING EFFECTS

TSOCs and U.S. joint staffs employ Operational Art and Design at the beginning of a campaign planning process. This method helps a commander identify the goals of a campaign or intervention. These goals are the commander's desired end states. End states define what the campaign should achieve and outline the required conditions for success.[124] Next, the staff identifies Centers of Gravity (COG) in relation to the end state.

121. Directorate of Future Land Warfare, Department of Defence, *The Australian Army in the Urban*, 31.

122. *Joint Urban Operations*, Joint Publication no. 3-06 (Washington, DC: Joint Chiefs of Staff, 2013), II-6.

123. Directorate of Future Land Warfare, Department of Defence, *The Australian Army in the Urban*, 31.

124. *Joint Operation Planning*, xx-xxi.

Joint Publication 3–0 defines Centers of Gravity as, "The source of power that provides moral or physical strength, freedom of action, or will to act."[125] COGs help staffs determine where to direct the main focus of military action. The direction of military action against COGs sets the conditions for success that bring about the desired end state.

At this point, staffs begin to apply the JOPP. This planning process provides a template that addresses the identification of COGs in Operational Art and Design. The first step of the JOPP calls for commanders to select objectives to assess vulnerabilities in the COG.[126] Upon completion of the mission analysis, the JOPP process focuses on the development of the courses of action, war-gaming, the comparison and selection of courses of action (COAs), and plan approval.[127] Planning staffs should ensure that COAs achieve the commander's objectives during operational planning. Objectives within COAs should nest with a COG to ensure that military action achieves the commander's end state.[128] Staffs should also develop measures of performance (MOPs), the assessment of tactical actions taken by a unit to achieve an objective, and measure of effectiveness (MOEs), the assessment of actions on an objective, to evaluate progress towards an objective.[129] Staffs use MOPs to ensure that troops execute an action properly and use MOEs to ensure that tactical actions achieve desired results. Together, MOPs and MOEs provide a feedback mechanism that allows commanders to evaluate mission success against an objective.

Commanders and staffs continually reevaluate MOPs and MOEs throughout the execution of a campaign to ensure that units meet objectives. However, unless directed by the commander, planners do not revisit COG analysis to ensure objectives remain nested with the end state. As a result, units can continually achieve their objectives according to all measures of effectiveness and still never achieve decisive gains against their long-term end state. For example, the U.S. Department of Defense's excessive focus

125. *Joint Operations*, Joint Publication no. 3-0 (Washington, DC: U.S. Joint Chiefs of Staff, 2011), GL-6.

126. *Joint Operation Planning*, III-4.

127. *Joint Operation Planning*, IV-1, IV-2, IV-4.

128. *Joint Operation Planning*, IV-6.

129. *Joint Operation Planning*, xxv, D-7, III-22.

on an enemy body count led commanders in the Vietnam War to assume they were making decisive gains against the Viet Cong and North Vietnamese Army (NVA). In reality, commanders did not know the true effect of their actions on enemy strength; body counts did not reveal the effects of tactical actions on the enemy.[130] Conversely, the U.S. military in Operation Iraqi Freedom reasoned that the reduction of coalition casualties was a MOE of suppressing the Improvised Explosive Device (IED) threat. In some cases, IED incidents actually rose but improved IED protection meant that fewer deaths resulted from contact.[131] In both cases, the military pursued MOEs nested with objectives that had no significant bearing on the enemy COG. See Figure 1.

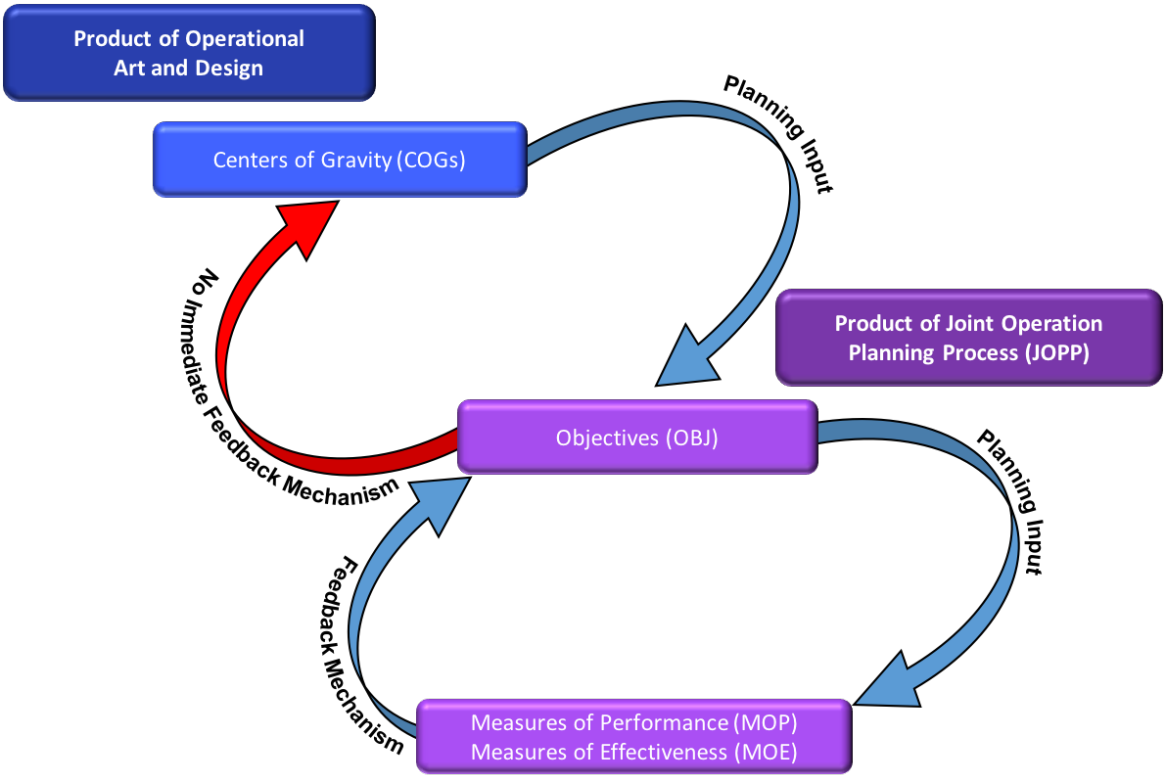

Figure 1. Planning Relationships Between – Centers of Gravity, Objectives, and Measures of Performance and Measures of Effectiveness.

130. Ben Connable, *Embracing the Fog of War: Assessment and Metrics in Counterinsurgency* (Santa Monica, CA: RAND, 2012), 110-111.

131. James Clancy and Chuck Crossett, "Measuring Effectiveness in Irregular Warfare," *Parameters* XXXVII, no. 2 (Summer 2007): 89.

Ideally, planners should include a continual revision of COG analysis alongside the operations cycle and JOPP. One reason that operational planners may not reevaluate their COG analysis is because they lack sufficient data. Megacities are no exception to this reality; they are extremely complex and fluid and often have multiple, dynamic, and quickly changing COGs. As will be argued, rather than attempting to identify and isolate one single COG, it would be more useful for staff planners to adopt a model that accounts for complexity and scalability in megacity interventions. For example, a planning staff could create feedback mechanisms that show changes in the environment relative to the desired operational end state; this approach would allow planners to adapt and modify courses of action in real time.

B. CASE BASED REASONING (CBR)

Case-based reasoning (CBR) is the process of adaptive problem solving.[132] CBR is a foundational concept in the experiential learning model (ELM), a method of training and conditioning heavily employed by Special Operations Forces (SOF).[133] ELM focuses on scenario-based training that compels forces to adapt their responses in order to achieve a current desired outcome. For example, in a training scenario, a shooter enters a room with only a set of conditions in mind that will drive him to shoot (e.g., a person is aiming a gun) or not shoot (e.g., a person is not aiming a gun). Once he is proficient in exercising this model, new variables are introduced into the room for him to process. Performance coaches provide immediate feedback so the shooter can more accurately pinpoint flaws in his thought process, make corrections, and reengage the problem. Over time, the shooter builds an adaptable mindset that allows him to rapidly interpret new information about his operational environment and adjust his actions accordingly.[134]

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132. Ian Watson and Farhi Marir, "Case-Based Reasoning: A Review," AI-CBR, Dept. of Computer Science, University of Auckland, New Zealand, accessed April 17, 2016, http://ai-cbr.cs.auckland.ac.nz/classroom/cbr-review.html#History of Case-Based Reasoning.

133. *Questions to Ask Throughout the Experiential Learning Cycle (ELC)* (Indianapolis, IN: Center for Teaching and Learning: Indiana University-Purdue University Indianapolis Consortium for Learning and Scholarship, 2008), 1.

134. *Questions to Ask Throughout*, 2.

Planners can use CBR and ELM to provide a structure for an adaptive decision-making process when intervening in a megacity.[135] CBR allows the incorporation of information into decision making through feedback mechanisms, which require continual reassessment of the environment, resulting in a deliberate change of military action.[136] Although this method of processing information appears natural, efforts to exercise command and control and a dense bureaucratic decision-making process often hinders its application.[137] While CBR may not immediately generate the optimal solution to a problem, its rapid execution makes it a useful method for processing information in a complex and emergent environment posed by megacities.

C. MULTI CRITERIA DECISION MAKING (MCDM) USING ANALYTICAL HIERARCHY PROCESS (AHP)

Decision making amid complexity requires planners to consider many alternatives with many interrelated factors. Planners' chosen course of action should have measurable characteristics and verifiable reasons for selection. MCDM is a scientific decision tool that can incorporate multiple alternatives and criteria.[138]

One type of MCDM is the Analytical Hierarchy Process (AHP). AHP breaks problems down into subsets of small problems and allows qualitative data or a mix of quantitative and qualitative data for analysis. AHP includes a predetermined ranking scale from 1 to 9 that facilitates weighting and pairwise comparison of alternatives and criteria.[139] The process consists of two basic steps. First, it determines the ranking of the decision criteria by assigning weight (1-9) to their perceived value. Second, it determines

135. Thomas Anderson et al., *Vector Relational Data Modeling (VDRM and Global Information Network Architecture (GINA))* (contribution to the "Conceptual Modeling in Megacities Conference" symposium conducted at TRADOC Analysis Center, Monterey, CA, March 8, 2016).

136. Janet L. Kolodner, *Case-based Reasoning* (San Mateo, CA: Morgan Kaufmann Publishers, 1993), 8.

137. Williamson Murray, *Military Adaptation in War*, report no. P-4452 (Alexandria, VA: Office of Net Assessment, Office of the Secretary of Defense, 2009), 1–20.

138. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10.

139. T. Saaty, "An exposition of the AHP in reply to the paper Remarks on the analytical hierarchy process by JS Dyer," *Management Science*, 36, no. 3, (1990), 259–268.

the relative ranking of the alternatives in comparison to the weighted criteria. The model numerically and graphically provides a prioritized objective ranking of the alternatives, modeling the nearest distance from the ideal solution. Finally, the decision maker can choose to either accept the ranking of the actions and their alternatives or revise the model to better reflect emerging considerations. Overall, the process structures problems, prioritizes alternatives, and facilitates group decision making when a consensus is difficult or impossible to achieve.[140] The model's versatility equips planners with the knowledge of what may happen when underlying criteria change. In other words, AHP helps to answer the questions, "Which one do we choose?" or "Which one is best?" when underlying conditions in the environment change.[141]

D. OPERATIONAL PLANNING IN A MEGACITY

Building on these conceptual models and the different approaches they provide for problem solving, this section proposes the Urban Intervention Model (UIM) to aid planners facing possible military interventions in megacities. It is a four-step model developed to mirror CBR and provide a process model aimed at generating real-time actionable information for planning and executing operations in a megacity. The UIM Step 1 combines the JOPP steps of mission analysis with course of action development, analysis and comparison. The JOPP steps produce MOEs, MOPs and objectives prescriptively while the UIM produces equivalent outputs non-prescriptively that mirrors CBR and ELM. UIM Step 2 mirrors order development within JOPP, and Steps 3 and 4 complete the framework by covering execution of operations and providing for the continual re-evaluation of mission success. See Figure 2. Overall, the UIM is rapid and more decentralized than the JOPP steps.

140. T. Saaty, "An exposition of the AHP," 259–268.

141. Fox, "Multi-Attribute Decision Making &," 1-10.

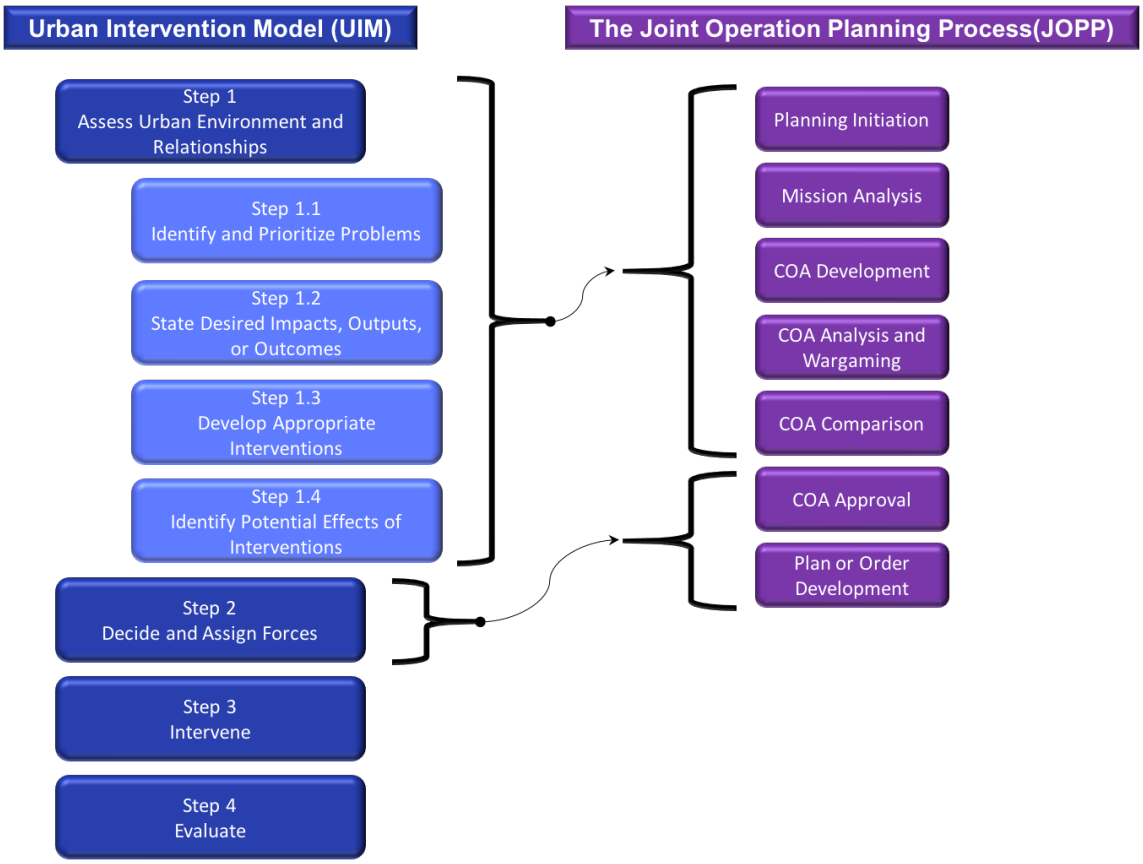

Figure 2. Where the Urban Intervention Model (UIM) Fits with the Joint Operation Planning Process (JOPP)

Step 1, *Assess Urban Environment and Relationships*, consists of four sub steps that illuminate key factors and their relationships to one another in the operational environment. The sub steps are as follows: 1.1 *Identify and Prioritize Problems*, 1.2 *State Desired Impacts, Outputs, or Outcomes*, 1.3 *Develop Potential Appropriate Interventions*, and 1.4 *Identify the Potential Effects of Interventions*. Step 1 provides a snapshot of the environment, and the planner relies upon past operational experiences to identify which considerations are immediately relevant to the crisis at hand. Past experience will not perfectly inform the most appropriate actions the planner should take, but it is the best position to begin planning potential actions. The planner must divorce traditional planning paradigms from his own operational experiences to inform this step. For this reason, past operational experiences provide a template for success or failure to inform intervention-specific decisions to act or not to act. The diversity of staffs'

operational experiences, in conjunction with the application of the UIM, combines multiple perspectives to create more resilient solutions against megacity-specific challenges than operational experiences alone. This is the planner's "context," that allows him to map previously successful solutions to the current environmental picture through CBR and then to make a decision. In this way, the UIM prevents the prescriptive reduction of the environment offered by traditional planning models. Traditional planning models force the staff to concentrate on just a few variables such as infrastructure and the control of space. A rigid planning process fails to incorporate all available information. The UIM offers a flexible model to incorporate all available information.

Step 1.1 *Identify and Prioritize Problems*, identifies key problems related to the crisis and generates a simple problem statement. A key problem could be a combination of several contributing problems. For instance, when an airport or seaport has been damaged or destroyed the key problem identified is "*infrastructure*," and the problem statement might read, "*Seaport is damaged and inoperable; no alternate seaports exist within a 100-mile radius of city. No cargo is incoming or outgoing.*" By the end of this step, planners should identify all knowable key problems relative to the planner's knowledge, experience, and access to information. The problems and statements that planners generate should be deliberately scoped to include both problems the planner expects to address and also take all efforts to consider problems that they do not expect to address by thinking far beyond the immediate problem and by considering how systems are related to and affect one another.

At the end of Step 1.1, planners prioritize problems to allow focused development in subsequent steps. They determine which problems and how many problems are the most relevant to the crisis at hand. When the number of alternatives and the number of criteria are many, consensus decision making may be difficult, if not unattainable. When consensus is unattainable, planners should use decision tools such as AHP to rapidly reach solutions that account for multiple perspectives. Chapter IV will further elaborate on this point.

Step 1.2, *State Desired Impacts, Outputs, or Outcomes*. This sub-step generates the desired impacts, outputs, or outcomes for every key problem and problem statement.

Building upon the above mentioned example, “Seaport is secured, Seaport is repaired, Temporary seaport is established in the vicinity of the damaged port, Flows of sea cargo are able to come into city, etc.,” are all impacts, outputs or outcomes. This step directly addresses the problems from Step 1.1 and develops desired impacts, outputs, or outcomes based upon the planner’s knowledge, experience, and access to information.

Step 1.3, *Develop Potential and Appropriate Interventions*. This step identifies possible intervention types that appropriately address each problem statement and considers the desired impacts, outputs, or outcomes generated in the previous step. For instance, planners could consider the following intervention actions for the problem statement in Step 1.1: “Intervention 1- Provide assessment team to damaged seaport, Intervention 2- International partner provides material support to seaport, Intervention 3- Carrier Strike Group provides logistical and security support to seaport until port is repaired.” Once planners identify the intervention actions, they conceptually expand each intervention by answering the following: conceptualize where not to do, conceptualize where to do, conceptualize with whom not to do, conceptualize with whom to do, conceptualize what not to do, conceptualize what to do, conceptualize when not to do, conceptualize when to do[action]. This process defines the relationships of action, actor, location, and time necessary within the intervention for mission success.

Step 1.4, *Identify the Potential Effects of Interventions*. Planners conceptualize the potential effects that should or should not be created for each intervention type previously identified. Continuing with the seaport example, possible effects include: “Should arrive at seaport as soon as possible, by any means available, to restore the flow of cargo; should liaise with local dock workers and supervisors to gain local knowledge; should not impede the flow of cargo into city; should not increase risk to ships transporting cargo, etc..”

After completing the four sub-steps in Step 1, the planner has identified key problems, prioritized them, stated desired impacts, outputs or outcomes, developed potential interventions, and identified the effects that should and should not be created through intervention. Steps 1.1 through 1.4 are an iterative process where planners use experience and consider it against historically relevant criteria to achieve the desired

outcome. The first iteration identifies whether or not past solutions are appropriate for current circumstances and prompts a rapid decision by the operator. The planners reevaluate and refine context by considering the reprioritization of criteria, to reach a more optimal solution. Running through the urban intervention model as a "thought experiment" can rapidly model or "war game" potential solutions until the decision maker decides to commit to a way forward.

Step 1 should also focus on the application of megacity specific knowledge, presented in Chapter Two, to inform necessary criteria and actions. For instance, it may be useful to know how political power diffuses throughout the city, where the governance gaps exist, or where force ratios are insufficient. Planners combine military experience and training to develop a better picture of the environment by following each of the four sub steps.

Step 2, *Decide and Assign Forces*. This step requires the planner to make a preliminary decision to intervene or not and then to assign the most appropriate forces based upon the desired effects. The JOPP equivalent step is "course of action approval and order development." The AHP decision tool analyzes qualitative and or quantitative data associated with intervention types, generated in Step 1. This process informs decisions to intervene or not, and decisions of which kinds of forces to commit.[142] Military commanders and planners should consider the right combination of boots on the ground (military), shoes on the ground (civilian), and remote activities performed via intelligence, surveillance, and reconnaissance (ISR), cyber action, and so on.[143] The decision tool provides a ranked order of best alternatives according to planner-generated criteria. In turn, the ranked order provides a mathematical vetting of the perceived best course of action or right force for the effects needed. As such, planners view rankings as a planning consideration and not an authoritative direction. This tool helps facilitate group consensus when the complexity of the problem obscures simple decision making.

142. T. Saaty, "An exposition of the AHP" 259–268.

143. André Kahlmeyer, "Urban Resiliency, Boots of the Ground vs. Shoes on the Ground" (paper presented at NATO Urbanisation Experiment, Modelling And Simulation Centre of Excellence (M&S COE), Rome, IT, September 25, 2015)

This step produces a decision to intervene or not and chooses the force composition in the event of an intervention.

Step 3, *Intervene*. This step introduces external forces to the megacity according to the intervention decided upon in Step 2. The impetus of this step centers upon the achievement of desired effects and the prevention of undesired effects. For instance, successful intervention actions result in prevented terror attacks. Intervening forces need to visualize their actions in terms of effects prior to taking action in the megacity. To do this, planners can war game to contemplate or conceptually simulate actions by running them through Steps 1.1 to 1.4. The continual re-visitation of these steps embodies the principles of the experiential learning model. Additionally, timely feedback from intervening forces within the city remains crucial to updating the common operating picture of the entire city.

For experiential learning to have an effect, planning and execution should be decentralized. This approach in turn helps foster adaptability, which allows intervening forces to cope with emergent situations at all levels of conflict. As such, every unit should have some level of visibility with other elements to incorporate or avoid similar actions. It remains incumbent upon the Task Force, or other higher headquarters, to determine the desired overarching effects, objectives, and end states of the intervention into a megacity. They should also facilitate the common operating picture for the entire city to include successful and unsuccessful attempts to achieve desired effects and the overall mission.

Step 4, *Evaluate*. This step determines whether conditions assessed in Step 1 have changed or not. If conditions have changed then the planner should return to Step 1.1 and update changes to Steps 1.1 to 1.4. Once operations achieve the desired end state, planners give careful consideration to the cessation of intervention activities. Any changes will have effects, and the planners must equally consider these effects during retrograde as during deployment. Removing forces from the battlefield will have an impact or effect upon conditions in the city. The UIM can illuminate courses of action for retrograde by considering *who, what, when, and where* actions need to continue after external forces have left. The Urban Intervention Model is summarized below.

Urban Intervention Model

Step 1 - Assess Urban Environment and Relationships
- 1.1 Identify and Prioritize Problems
- 1.2 State Desired Impacts, Outputs, or Outcomes
- 1.3 Develop Potential Appropriate Interventions
- 1.4 Identify the Potential Effects of Interventions

Step 2 – Decide and Assign Forces
Step 3 – Intervene
Step 4 – Evaluate

E. CONCLUSION

The UIM can assist the integration of planning efforts at any level if a crisis necessitates a rapid assessment, operations require decentralized decision making and action, and the environment is complex. These points are especially true when the megacity is in crisis and has rapidly changing dynamics. The proposed UIM incorporates case-based reasoning into planning to allow forces to remain adaptable in the face of rapidly changing environments, and to make forces aware of how their actions can generate effects in the environment. The model is flexible enough to incorporate any kind of sensory input, and ground forces can easily gather information and use Step 1 to conceptually understand their actions in light of new conditions once deployed. Moreover, planners can collect diverse perspectives from across the battlespace to disseminate successful or unsuccessful actions and effects. Within this approach, the UIM incorporates AHP to prioritize problems or courses of action. Finally, planning staffs can use the UIM as a training platform to improve their ability to make rapid and accurate decisions through experiential learning model and coordinate actions and effects in complex environments like megacities.

Chapter IV will use the UIM to analyze Cairene, a fictitious megacity hit by a major earthquake, and generate a TSOC's hypothetical response to this disaster.

IV. URBAN INTERVENTION MODEL APPLIED

Chapter III argued that current military planning lacks the ability to fully account for the complexity of megacities and introduced case-based reasoning, the Experiential Learning Model, and the Analytical Hierarchy Process as means to address the complexities of megacities. Applied together, these concepts and models form the four-step Urban Intervention Model (UIM), a potential solution to doctrinal gaps that would enhance military intervention planning for megacities. Chapter III then proposed that the UIM can assist with the integration of planning efforts at any level where the environment is complex, a crisis necessitates a rapid assessment, or operations require decentralized decision making and action.

This chapter applies the UIM to a fictional scenario, a major earthquake in the megacity of Cairene, that shows many of the characteristics and complexities that exist in most megacities today. The chapter first focuses on applying UIM Steps 1.1 through 1.4, then demonstrates important considerations for Steps 2 through 4. Following the application and consideration of the specific UIM steps, Chapter IV goes on to discuss the benefits, challenges, outputs, and outcomes that result from the UIM application in a megacity. The chapter then concludes by showing how the UIM can serve as the foundation for understanding complexity in any environment.

A. THE MEGACITY – CAIRENE

Cairene, a megacity, is home to 18 million people. Cairene stretches over 214km² with a population density of 10,500 people per km². Containing 50% of the country's population and contributing 80% of the country's GDP, Cairene is the political, cultural, religious, and economic center of the country. Consequently, Cairene´s city government exerts great regional and international influence. The country's major river, the lifeline of the city, provides the primary water source of drinking water to the city and connects Cairene with the ocean. The city´s seaport transfers the majority of Cairene's food, commercial, and raw material supplies from cargo ships via rail transport into the city. Cairene International Airport, the city's only airport, is located ten kilometers northeast

of Cairene and consists of three runways and four passenger terminals. It is the region's second busiest airport and is essential to the regional flow of goods and people.

Cairene consists of four official administrative divisions: the government, the commercial, industrial, and residential districts. The government district is the national and city seat for all government institutions. The separation between municipal and national government is almost indistinguishable, and corruption and nepotism is the norm. The commercial district features grocery markets, retail outlets, and restaurants that provide all manner of goods and services to both residents and tourists. The industrial district, home to the city's airport, seaport, and power plant, is also where large-scale manufacturing produces the majority of the city's goods for both internal and external markets.

The city´s population lives in the residential district, subdivided into three distinct boroughs, the upper class (9% of population), the lower to upper middle class (53% of population), and the slums (38% of population). Cairene's poorest residents live in the slums, a series of unofficial settlements spread along the periphery of the industrial district. The city center, where the government and commercial districts meet, is the political and cultural heart of the city, also known as "Little Dubaike." The middle and upper class residential districts immediately surround the city center. The industrial district and the slums are scattered around the periphery of the middle and upper class boroughs. The majority of the city, with the exception of the slums, has full access to water, electricity, sewage, trash removal, and other government services. The municipal government does not attempt to provide services to the slums, stating that they are not officially recognized housing settlements.

All of Cairene experiences heavy traffic congestion due to insufficient infrastructure, insufficient capital investments, insufficient public transportation systems, technical incompetence, corruption, excessive individual use of motorized transportation, and the overall volume of transportation. Daily traffic jams bring the city to a standstill for several hours, paralyzing traffic flow in the city. Cairene relies heavily upon rail to transport goods to and from the seaports; however, the rails do little to ease the traffic congestion within the city. Due to a shortfall in rail cars and frequently inoperable, aging

locomotives, trucks end up carrying over 70% of all cargo between the industrial district and the end user. With trucks as the primary means of distribution within the city, in addition to traffic slogs, auto emissions create a smog-clad environment, heavily affecting the respiratory health of all city dwellers.

Cairene's emergency services – police, fire, and ambulances – operate throughout the city, but not in the slums. Although known for internal corruption, the police are a professional force that maintains security and rule of law. The police allow criminal elements in the slums to operate with impunity so long as conflicts within the slums do not affect areas outside the slums.

Fire and ambulance personnel have medical training to provide basic first aid until patients reach one of the city's four major hospitals, all located in the city center. However, severe traffic congestion throughout the city greatly hampers the response time to emergencies. As a result, the injured and sick do not rely on ambulances, but instead they rely upon themselves or family members to reach the hospitals. Most middle class residents, especially with lower incomes, prefer to avoid the hospital altogether and instead visit the smaller free health clinics spread throughout the city. These clinics provide little more than basic family care and have almost no trauma capability. Although these clinics are free, patrons must prove legal residence by providing an address and a city issued identification card. These clinics often deny healthcare to those living in slums because they cannot prove official residency. The upper class relies upon private health care providers who charge a premium for their services.

The slums pose a growing concern for Cairene. Nearly 40% of the city's population lives in slums with low or no income at all. Due to rapid influx of immigrants from the region's poorest countries, coupled with the country's rural poor migrating to the city in search of work, Cairene's population has grown 50% over the last ten years. These immigrants build temporary dilapidated housing adjacent to existing indigenous slums. Now, immigrant and indigenous slums comprise one contiguous ungoverned zone. Slum dwellers compete among each other for both housing and jobs, leading to increasing tensions and sporadic violence with no police protection. As a result, criminal elements emerged from both the indigenous and immigrant populations to provide

limited security and exploit existing black markets for water, electricity, and fuel within the slums.

B. NATURE OF CRISIS – EARTHQUAKE 9.0

At 0200 on 1 June, a 9.0 magnitude earthquake hits Cairene. Instantly, more than 100,000 die and another 1.2 million residents are severely injured. Because the crisis occurs at night, most die or suffer injuries in their homes. The higher quality construction of the middle and upper class boroughs withstands most of the devastation; at the same time, much of the multi-story slum housing collapses, emergency responders concentrate their effort on the middle and upper class boroughs, despite the fact that 70% of all casualties are in the slums.

The earthquake also severely degrades critical infrastructure including the city´s airport, seaport, and power plant, threatening millions more lives and hampering relief efforts. The airport´s runway itself remains functional, but the earthquake destroys the airport control tower, eliminating all possibilities of air traffic. The seaport suffers severe losses, including the destruction of several wharfs and adjacent storage facilities. The earthquake causes minimal damage to the power plant, but the earthquake disrupts the distribution network at countless locations preventing the distribution the flow of electricity. Transportation networks are impassable due to debris covered roads and severely bent railway tracks, preventing the effective distribution of food, water, and medical supplies from the ports into the city while also slowing the efforts to restore the electric grid.

There are no immediate security threats as survivors are working to secure their possessions or rescue/recover family from the rubble. Still, if the municipal government does not meet the demand for food, water, electricity, and medical assistance, the security condition will rapidly worsen, creating a hostile environment. The city government expects the slum dwellers to take the advantage of the situation, including looting parts of the destroyed city for copper and other valuables. The delicate security situation might entice criminal networks to emerge from the slums in response to the needs of the people

and take advantage of the city government's lack of capacity to expand their influence through coercion and robbery.

By 0400, two hours after the earthquake, city crews have mounted a hasty emergency response in the middle and upper class boroughs, recovering survivors and transporting victims to the hospital. However, the four city hospitals are over capacity, and it is evident that, unless international aid organizations augment the medical staff, victims may perish before ever seeing a doctor. The smaller health clinics and private doctor offices are also full and turning patients away. Furthermore, there are no municipal emergency response assets to dedicate to the slums. By 1400, city officials still do not have an accurate estimate of the damage or casualties within the slums.

By 2300, the city government manages to get the power plant online, but downed power lines and electrical cables still prevent whole sections of the city from receiving electricity. More significantly, blocked roadways continue to prevent the flow of traffic to and from the industrial center, and the seaport and airport remain inoperable. Anticipating the need for foreign aid, and in an attempt improve the distribution of food, water, and medical supplies, city road crews are opening one route from the industrial district to the city center and between all four hospitals. However, throughput along this roadway is insufficient, and drivers have to stockpile cargo in makeshift holding yards. It is clear that Cairene cannot handle this disaster on its own, but in order for the international community to assist Cairene, the airport and roadways must be open.

Within the first 24 hours after the earthquake, the World Health Organization, the European Union (EU), the African Union (AU), the Organization of the Islamic Conference (OIC), and a host of international coalition partners pledge immediate support, but they need the assistance of U.S. government operational and logistics support to facilitate the flow of food, water, medical supplies, personnel for rescue and recovery support, as well as general humanitarian aid to ease the suffering of the Cairene population. Specifically, the military must first open the airport to receive, store, and distribute aid.

C. CAIRENE CASE

The Cairene case scopes the application of the UIM from a single staff section perspective in the first iteration and then incorporates greater megacity complexity in the second iteration. One chapter cannot fully address the complexity of a megacity crisis. However, applying the UIM to Cairene demonstrates basic capabilities with room for further development and testing. The Cairene case examines Steps 1.1 through 1.4 in detail through the eyes of the TSOC J3 (Director of Operations and Planning) and demonstrates Steps 2 through 4. Additionally, Appendix B contains further considerations for applying the UIM to the Cairene case.

D. BACKGROUND INFORMATION FOR THE TSOC J3

The TSOC J3 staff uses the UIM to plan the military intervention in Cairene in the immediate hours following the earthquake. First, the TSOC commander directs the J3 to support the international community's relief efforts to provide aid in the first 72 hours after the disaster and until the Department of State can take over operational control of all relief efforts. The transportation/distribution network is the COG because its degraded state directly hinders the mission by preventing the flow of aid. The European Union (EU) has offered naval assistance on behalf of Germany, France, and Great Britain to help open the seaport nearest to Cairene. This relieves the U.S. military of most maritime obligations for the intervention, but the seaports will not be operational until 17 June.

Therefore, overland and aerial transportation are the only viable options for immediate intervention. While the United States Agency for International Development (USAID) has contracted crews travelling overland towards Cairene to assist with road clearing, the destruction at the airfield remains unaddressed. The United Nations has dedicated staff from the World Food Programme (WFP) and the World Health Organization (WHO) who are prepared to facilitate the distribution of food and medical aid once the Cairene International Airport is operational. The J3 must recommend the number and type of forces for intervention to the TSOC Commander for approval. The J3 must conduct hasty planning, so the TSOC can rapidly disseminate information and coordinate amongst interagency and host nation partners.

First, the TSOC J3 issues the following planning priorities to the TSOC staff:

> The desired end state is the restoration of Cairene's ability to receive and distribute aid from the international community. Any disruption of timely aid delivery or interrupted government services will likely result in local and then possibly regional security instability. Within the next 72 hours, the staff should immediately focus on opening the flow of aid into Cairene. Once aid is flowing into Cairene, shift planning priorities to assist local security forces with stabilization. The TSOC will continue to support the U.S. Department of State once they are in the lead.

The airfield is the most important decisive point in the transportation/distribution network because opening it will facilitate the reception of relief efforts, directly contributing to the achievement of the end state. Additionally, without the airfield as a viable ingress route for security assistance forces, the TSOC cannot assist the local government in stabilization. Therefore, the TSOC J3 Air (Director of Air Operations) is the main effort for surging initial support to Cairene.

E. UIM APPLICATION: FIRST ITERATION – STEP 1

Step 1 illuminates key objects and relationships in the operational environment, which provides context for further decision-making in Step 2, *Decide and Assign Forces*. Step 1 provides a snapshot of the relevant factors in the environment, and the planner relies upon UIM reasoning and the commander's guidance to identify which considerations are immediately relevant. The J3 staff brainstorms potential measures of performance (MOPs) and measures of effectiveness (MOEs) in Steps 1.3 and 1.4, respectively. The TSOC staff sections each use the UIM, completing Step 1, and deliver their planning estimates to the J3. See Appendix B for complete Cairene case. The following is the J3 Air's planning estimate:

Step 1.1 Identify and Prioritize Problems

- Infrastructure: The earthquake damaged the air traffic control system, rendering it inoperable. No emergency air traffic control capability exists at Cairene International Airport. There are no incoming or outgoing aircraft. Blocked roadways prevent the flow of aid and resources from Cairene International Airport into the city.

The information in Step 1 becomes the staff's key planning problem because it identifies and prioritizes for the influx of aid. Opening the airport becomes the first planning priority, and the J3 must subsequently address all other key problems.

Step 1.2 State Desired Impacts, Outputs, or Outcomes

First key problem: Infrastructure – The earthquake damaged the air traffic control system, rendering it inoperable. No emergency air traffic control capability exists at Cairene International Airport.

- Establish emergency air traffic control
- Reestablish local air traffic control capability
- Secure airport
- Open flow of aid to airport
-

Step 1.3 Develop Potential and Appropriate Intervention Actions

The potential actions listed in Step 1.3 are MOPs used to assess whether the TSOC is performing its tasks correctly, while the determination of effects that the intervention should and should not create, found in Step 1.4, serve as MOEs.

- *Action 1*: TSOC facilitates local air traffic controllers to resume operations
- *Action 2*: International partner provides emergency air traffic control
- *Action 3*: Special Tactics Teams (STT) provide emergency air traffic control
- *Action 4*: Force Contingency Response Group (CRG) provides emergency air traffic control
- *Action 5*: Combat Communications Group (CCG) provides air traffic control systems (tower, TACAN, radar, et cetera)

A. The planner conceptualizes the details of every intervention action type above. While Appendix B contains examples for all action types, the details of Action 1 are shown below:

Action 1: Special Tactics Teams (STT) provide emergency air traffic control:

- *Where not to do action*: non-standard runways (dirt, and or makeshift airfields)

- *Where to do action*: Cairene International Airport (confirm length of runways, identify aid storage areas; confirm noncombatant evacuation routes and staging areas)

- *With whom not to do action*: unaffiliated third party personnel to Cairene International Airport. (personnel not employed or authorized to conduct operations at the airport)

- *With whom to do action*: technically experienced local nationals including: air traffic controllers; airport security personnel; technical avionics contractors; personnel whose association gives decisive access to a vital areas or objects; combined military and civilian personnel

- *What not to do*: permanently replace local air traffic controllers; introduce large numbers of external forces

- *What to do*: temporarily provide air traffic control assistance; assist with reestablishment of the local air traffic control capability; possible; ensure insertion method is appropriate for destination

- *When not to do action*: an alternative with better capabilities becomes available; Cairene no longer needs aid

- *When to do action*: provide emergency air traffic control assistance within 24 hours; upon receipt of request for assistance from Cairene

Step 1.4 Identify the Potential Effects of Interventions

Action 1: Special Tactics Teams (STT) provide emergency air traffic control:

- *Effects that should not be created:* do not want to exclude local air traffic controllers from operations, even if they cannot use their equipment; do not allow local air traffic controllers to resume full control of operations until they are able to safely direct air traffic

- *Effects that should be created*: the international community and foreign militaries support Cairene´s population; should consult with local air traffic controllers to gain their knowledge for operations specific to Cairene; should

identify and facilitate the equipment, expertise, and capabilities air traffic controllers need to reestablish local control of operations

- *Effects of not taking this action*: Cairene must rely upon its own resources to provide aid to the population until it is able to open the airport; international community does not supply aid or provide military forces; food and medical shortages increase rapidly in Cairene and competition over these scarce resources creates conflict in Cairene

- *Effects of taking this action*: demonstrates the international community's and foreign militaries support to Cairene's population; immediate air traffic control operations allow a greater amount of aid to flow into Cairene within 24 hours, thus reducing human suffering; Cairene receives a sufficient amount of aid to meet the peoples' demands; competition for aid will decrease in Cairene – this may prevent escalating conflict within Cairene U.S. military assistance addresses moral and bi-lateral obligations to the affected people in Cairene; immediate air traffic control operations that open the flow of aid could avoid the spread of regional instability and supports U.S. national interest; the STT maintains a small footprint at the airport creating the impression that the U.S. military presence is not interfering in the country's affairs; there will also be lower costs in manpower and resources for related security and sustainment operations of forces on the ground

Note: All identified intervention actions are repeated in the above manner. See Appendix B for *Action 1* through *Action 5*.

The J3 chooses from proposed actions created in Step 1 to inform decision making in Step 2.

F. UIM APPLICATION: FIRST ITERATION – STEP 2

Step 2 gives careful consideration to the overall strategy to determine whether or not an intervention should occur. Step 1.3 listed several actions that the planner must now choose from, prioritize, and then assign appropriate MOPs and MOEs. MOPs measure a desired actions completion. For example, if the J3 chooses Action 1: TSOC facilitates local air traffic controllers to resume operations, then the completion of local air traffic

controllers resuming operations is the basis for measuring performance. Upon completion of the task, MOEs help the J3 to determine an action's effectiveness. MOEs are the list of desired effects outlined in Step 1.4. If, for instance, the J3 finds that immediate air traffic control operations do not allow a greater amount of aid to flow into Cairene, then the J3 can conclude that completing Action 1, while appropriately executed, failed to generate the desired effect. Monitoring effects helps the J3 to know when to adjust the plan. However, in addition to determining which actions in Step 1.3 to take, the J3 must also choose which forces are best suited to the task. The impetus for these considerations should be to leverage existing local personnel, equipment, and resources to accomplish the mission in the shortest time and with the fewest amount of external resources.

Step 2 shows the application of the Analytical Hierarchy Process (AHP), a multi-attribute decision making tool, to process the consideration of multiple intervention types and criteria when no alternative solution is clear.[144] In this case, the J3 must choose between multiple units with similar capabilities and competencies. The AHP decision support tool can also be applied to any step in the UIM. Furthermore, the AHP allows a sensitivity analysis function to further analyze results. The sensitivity analysis shows the flexibility and robustness of courses of action when the priorities of criteria change, or when environmental dynamics force the implementation or removal of criteria.[145]

The J3 staff identifies eight criteria it finds most important to the strategic and tactical missions for the intervention based upon the national strategic planning guidance and the GCC commander's planning guidance. The J3 exercises judgement and ranks the criteria in the following order to assess potential intervention actions: *Moral Obligation*, *Capacity of Flow*, *Rapid Deployment and Flexibility*, *Building Capacity*, *Risk to Own Troops*, *Regional Stability*, *Obligation versus Cost*, *Intervention Conflict*. The J3 staff assigns weights to each of these criteria within the AHP tool. The staff then conducts a pairwise comparison of each criterion against all of the other seven criteria to determine

144. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10; Saaty, T. (1990). An exposition of the AHP in reply to the paper Remarks on the analytical hierarchy process by JS Dyer. *Management Science*, 36(3), 259–268.

145. Anderson et al., "Vector Relational Data Modeling."

their prioritized ranking.[146] See Appendix B for criteria definitions and the pairwise comparison of the criterion. The following criterion in Table 5 are ranked by the eigenvector value from highest to lowest values:

Table 5. Intervention Criteria Weighting and Eigenvector Values

Criterion	Value	Ranking
Moral Obligation	0.30	1
Capacity of Flow	0.28	2
Rapid Deployment and Flexibility	0.15	3
Building Capacity	0.10	4
Risk to Own Troops	0.07	5
Regional Stability	0.05	6
Obligation versus Cost	0.03	7
Intervention Conflict	0.03	8

The *Moral Obligation* criterion has the highest eigenvector value of 0.30, and it is immediately followed by the *Capacity of Flow* criterion with a value of 0.28 and the *Rapid Deployment and Flexibility* criterion with a value of 0.15. This simply means these criteria are weighted more heavily than the other criteria for decision-making.

In a next step, the J3 staff weighs each of intervention actions, from Step 1.3, against each of the eight weighted criteria above, by conducting a second pairwise comparison.[147] See Appendix B for the pairwise comparison.

Table 6. Intervention Actions Eigenvector Values

Alternatives - Intervention Actions	Eigenvector Value	Ranking
CRG and CCG - Contingency Response Group (CRG) and Combat Communications Groups (CCG)	0.37	1
STT– Special Tactics Teams	0.28	2
Advise Host Nation – not responsible for air traffic control operations	0.14	3
Air Drops – deliver aid without ground presence	0.13	4
No Support	0.07	5

146. Fox, "Multi-Attribute Decision Making &," 1-10.

147. Fox, "Multi-Attribute Decision Making &," 1-10.

As seen in Table 6, the *CRG and CCG* action receives the highest value of 0.37, and the *STT* closely follows with a value of 0.28. Both of these actions best addressed the eight criteria previously developed.

Finally, the J3 conducts a sensitivity analysis to consider the resilience of all alternative actions of underlying conditions that affect criteria change.[148] Based upon the consideration of all eight criteria developed and weighted by the staff, the sensitivity analysis results show that the *CRG and CCG* and the *STT* actions are the best suited choices given the immediate demand to open the airport. The *CRG and CCG* value of 0.37 and the *STT* value of 0.28 mean both intervention actions are resilient to change if the criteria change. In other words, if the weighting of criteria changes in time, the intervention types will still remain appropriate options. See Appendix B for detailed sensitivity analysis results.

The J3 assesses that the sensitivity analysis conducted in the AHP supports any combination of *CRG and CCG* or *STT*. The intervention actions with the highest values demonstrate which actions better address the eight criteria overall. These two combinations are much closer to the ideal solution than *Advise Host Nation, Air Drops*, or *No Support*. If any criterion changes, or if a new criterion is added, then the planners must recalculate the AHP and sensitivity analysis. The staff briefs the TSOC Commander and recommends introducing the *STT* because the *CRG and CCG* cannot deploy within 76 hours, while the *STT* can deploy within 24 hours. Therefore, the Commander decides to deploy the *STT* to open Cairene´s airport.

G. UIM APPLICATION: FIRST ITERATION – STEP 3

Step 3, *Intervene*, should incorporate the concepts of *what, where, with whom,* and *when* to take action for interventions. Once military forces are in the megacity, they confirm or deny the conceptualized intervention actions planned through assessments and interactions. The forces also validate assigned MOPs and MOEs, the actions and effects

148. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10; Saaty, T., "An exposition of the AHP in reply to the paper remarks on the analytical hierarchy process by JS Dyer," *Management Science*, 36, no. 3, 1990: 259–268.

developed in Steps 1.3 and Step 1.4, respectively. Feedback from ground forces to the TSOC drives updates to the common operating picture.

H. UIM APPLICATION: FIRST ITERATION – STEP 4

Step 4, *Evaluate*, is the point when the staff analyzes the feedback provided through MOPs and MOEs to determine whether the intervention actively achieves the desired end state. In the case of Cairene, the *STT* reopened the airfield and prepared to transition control back to the host nation. However, locals reported increased incidents of theft, bribery, and coercion. Furthermore, NGOs reported that armed gangs had extorted their drivers and prohibited aid delivery.

Interventions that fail to yield a desired result could indicate a shift in the COG. Reevaluation refines context and allows the planner to reprioritize criteria creating a better solution. The UIM as a "thought experiment" can rapidly model or "war game" potential solutions until the decision maker decides to refine or develop a new course of action. For Cairene, the TSOC evaluated the actions of the *STT* as effective. Specifically, the *STT* entered Cairene International Airport within 24 hours and provided emergency air traffic control for all incoming and outgoing aircraft meeting MOPs from Step 1.3. Also, the following MOEs were met from Step 1.4: within 36 hours after the earthquake, the *STT* was able to locate sixty percent of the local national air traffic controllers and began reestablishing local systems in order to resume operations at the airport; host nation contractors began repairing control tower equipment; the Cairene government ordered equipment repairs, and the *STT* estimates that it may be able to hand over complete operations to local nationals within thirty days. While the intervention actions listed above met MOEs and MOPs from Step 1.3 and Step 1.4, the nature of the problem on the ground changed, and the J3 must consider these new conditions and reevaluate its plan.

I. UIM APPLICATION: SECOND ITERATION – STEP 1

The J3 will reevaluate conditions in Cairene and decide to reinitiate the UIM in the wider context of preventing local and regional security destabilization. Appendix B contains the complete process. Local criminal elements operating out of the slums are

exploiting increased gaps in governance and rule of law. The most prominent criminal element greatly influences the Opposition Party, a minority political party representing the slums. TSOC analysts expect the Opposition Party to take advantage of the current instability to increase its power. According to local police reports, an unknown group murdered members of the city's Ruling Party near their homes. The murders appear to be well-organized hits rather than the work of amateur criminals. In addition, a combination of U.S. signals intelligence (SIGINT), local human intelligence (HUMINT), and intelligence services have intercepted communications from the regional terrorist organization to criminal leaders offering them money in exchange for committing acts of terrorism.

On 6 June, Department of State takes the lead in planning and organizing relief efforts while the TSOC focuses its resources against the emerging security threats. The TSOC J3 therefore issues the following revised planning guidance:

> Assist local and state security organizations in preventing the alliance of local criminal organizations with the regional terrorist organization. Exploit local knowledge and networks used by criminal organizations to entice them to assist Cairene officials in preventing terrorist or insurgent actions. When possible, disrupt, destroy, or neutralize the regional terrorist organization without implicating Western military forces or escalating conflicts.

The growing security threats and the dramatically improved flow of aid and services constitute a change in the COG. Therefore, the J3 directs the staff to re-run Step 1 of the UIM. The J3 staff determines criminal elements are the most significant security threat to municipal instability, while the external terrorist organization could also foster wider regional instability or instigate insurgent activities.

In Step 1.1 *Identify and Prioritize Problems*, TSOC planners identify criminal interests in Cairene slums, Opposition Party grievances with Ruling Party members, political inequality, and growing regional terrorist influence as key problems. These problems are categorized under the PMESII-PT headings of *Military*, *Social*, and *Government*. The PMESSII-PT factors are *Political, Military, Economic, Social, Information, Infrastructure, Physical Environment,* and *Time.* The J3 prioritizes

Government related grievances over *Military* and *Social* factors, since extending rule of law into the slums will contain the spread of criminal activity across the city and deny access to terrorist organizations.

Step 1.2 *State Desired Impacts*, *Outputs, or Outcomes*, leads to understanding the following: SOF cannot directly target the Opposition Party, yet the party's role is central to security threats emerging in Cairene; criminal elements rely exclusively upon illicit activities to meet their financial interests. If the Cairene government can become more inclusive of the opposition and formalize their relationship with criminal elements' leadership, then there could be an opportunity to reduce security threats. The desired outcome is to extend rule of law in the slums by co-opting and integrating local criminal leadership into formal governance and deny terrorist organizations access to the city.

Step 1.3 *Develop Potential and Appropriate Interventions* reveals that it is neither feasible nor appropriate to introduce a large external force into Cairene. Anti-western and terrorist groups could exploit the presence of large foreign military forces through their rhetoric. United States SOF can, however, advise local security forces on reintegrating criminal elements within municipal security and governance roles in the existing slums. SOF can also facilitate the dialogue between police and former rivals within the criminal organizations.

Step 1.4 *Identify the Potential Effects of Interventions* considers the effects of each intervention action and determines that Western military presence should be kept as minimal and as discrete as possible. Higher-level political discussions with the Opposition Party and Ruling Party should remain within Department of State channels, while continued dialogue between local security officials and criminal leaders should continue. Joint U.S. and local HUMINT efforts should focus upon identifying Cairene sources of support of the regional terrorist organization. Further identification will allow lethal and non-lethal targeting by host nation and coalition forces.

As SOF continue operations in Step 3 *Intervene*, each action is informed by the planning process to include *with whom to act or not act, what action to take or not take, when to act or not act,* and *where to act or not act*. As a result, rapid decision making, a

function of Step 2 *Decide and Assign Forces*, allows forces to counter widespread criminal activities, politically backed killings, and terrorist support actions. SOF further determine that continued low-level looting provides sufficient preoccupation and income to criminal organizations, therefore giving criminal elements less incentive to partner with the terrorist organization. As the dialogue between the criminal elements and the municipal government continues, several indigenous criminal leaders express interest in cooperating with the government while most immigrant criminal leaders refuse any communication.

Upon evaluating intervention actions in Step 4 *Evaluate,* the J3 decides to foster ongoing SOF-sponsored reintegration dialogues between select criminal elements and Cairene police. Regional state partners have offered to provide a military response to the terrorist activity in Cairene. The collaborative approach will reduce Western military presence, but the TSOC will facilitate intelligence sharing between regional partners. The Department of State works with government officials to broker a deal to bring no charges against the Opposition Party if politically motivated killings stop.

The J3 determines that the intervention actions have opened the flow of aid to Cairene and assisted local security forces in maintaining security and rule of law in Cairene. The TSOC provided leadership, planning, and resource assistance to the government to address human suffering and security concerns. The TSOC also determines that a small 'advise and assist' SOF presence is sufficient to maintain enduring support to Cairene's civil administration.

J. RESULTS

Prescriptive planning models, like JOPP, fail to allow for decentralized and rapid responses to unforeseen developments in highly complex environments. For instance, in August 2003, after the fall of Baghdad, U.S. military forces failed to stop looting in the city, and the effects from the breakdown of rule of law created a host of subsequent problems for coalition and Iraqi forces. If U.S. forces had access to and applied the UIM, they might have weighed the negative impacts of looting against the greater stabilization efforts, and they may have been better empowered to take corrective action. The UIM

empowers troops on the ground to determine what actions should be taken and with a better understanding of the reasons behind those actions. The fundamental thinking driving the UIM is not based upon prescriptive orders; instead, priorities are developed based on what *should* or *should not* be done given the complexity and the corresponding effects. When situations emerge during operations that are similar to previously identified conceptualizations of *what to do* or *not to do,* leaders and planners have past considerations to guide them. The decision to act or not to act can be made more rapidly and in a decentralized fashion.

K. CONCLUSION

Chapter IV began by describing Cairene, a fictional megacity faced with a highly complex situation following a massive earthquake. The TSOC J3 applied the UIM to assess the environment and its corresponding relationships by doing the following: identifying and prioritizing problems; stating desired impacts, outputs, or outcomes; developing potential appropriate interventions; and identifying the potential effects of interventions. The J3 then utilized assessment outputs to inform the decision on whether and how to intervene and applied a multi-criteria decision tool. Finally, the chapter described the results to show how the UIM might integrate with existing TSOC staff planning.

Chapter IV demonstrated that the UIM is an appropriate tool for comprehensive planning and execution of military operations in megacities. Planners used the model to deliberately integrate feedback mechanisms, prioritize problems, state desired impacts and outcomes, and develop appropriate interventions while considering effects of interventions. Chapter Five will discuss and recommend implications for future research and will present considerations developed from megacities to address complexity within urban environments.

V. CONCLUSION

This thesis began by asserting that megacities are complex systems that are continuing to grow, particularly in developing regions. The complexity of megacities, especially in developing countries, poses a unique and challenging environment for governance and security. Megacities in developing nations struggle with the ability to build adequate infrastructure and meet their populations' demands, including access to jobs, security, food, potable water, and education. Inadequate access to essential services increases the risk of disease on a grand scale.

Large populations and urban density in megacities are problems not only for local governance, but also for intervening forces and other and their ability to meet the needs of urban populations in the event of natural or manmade disasters. The sheer number and density of people living in a megacity require greater security forces than are likely available. Megacities are a new operational environment where nations have yet to test traditional strategies on such a grand scale.

Within this discussion on the proliferation of megacities, this thesis aimed to answer the following question: What do Geographic Combatant Commands (GCCs) and Theater Special Operation Commands (TSOCs) need to know about megacities, and how can they improve the planning process to more rapidly assess, synchronize, and guide military operations in megacities?

Chapter II provided an overview of megacities, including offering a working definition of megacities, and the unique challenges of governance and resource management for megacities. Chapter II then used this discussion to inform security concerns for military intervention. It detailed military considerations that highlight western militaries' unpreparedness to conduct operations in megacities.

Chapter III began by describing useful planning and conceptual models for understanding megacities from a military perspective. These models included the experiential learning model (ELM), joint operation planning process (JOPP), and the analytical hierarchy process (AHP). From this discussion, the chapter presented the

Urban Intervention Model (UIM), a four-part model that incorporates elements of the models listed above while presenting a new framework for planning urban interventions. The chapter concluded with a detailed explanation of the UIM's steps and sub-steps, and how they would be applied at the joint staff level.

Chapter IV used the UIM to plan a TSOC-led intervention into a fictitious megacity—Cairene—following an earthquake. In this scenario, damage from the earthquake overwhelmed the Cairene government's ability to treat casualties, repair damaged infrastructure, and deliver humanitarian aid. The U.S. government tasked the TSOC with restoring the Cairene government's ability to receive and distribute aid provided by the international community. From this description, the chapter provided a demonstration of how to apply each of the UIM steps within the scenario. The chapter ended with a brief discussion of the wider application of the UIM and operational considerations for military planners.

A. RECOMMENDATIONS

(1) U.S and NATO forces should consider designating cities as a new operational domain.

Historically, the United States and NATO only designated warfighting domains according to types of terrain (land, sea, air and space) with the aim of developing core competencies within the armed services.[149] The United States military designated cyberspace as the fifth warfighting domain of warfighting and created Cyber Command in 2009 as the proponent tasked with the responsibility to develop and implement doctrinal and operational solutions relevant to the cyber environment.[150] Establishing cyberspace as a distinct domain also acknowledged the need to dominate non-physical environments that span multiple forms of geography. More recently, the United States military has considered naming the human domain as the sixth realm of warfighting, acknowledging the centricity of human thought and action in warfare.

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149. Peter Dombrowsk and Chris Demchak, "Cyber War, Cybered Conflict, and the Maritime Domain, " *Naval War College Review* 67, no. 2 (Spring 2014): 74.

150. Thomas Doherty, "Should There Be a Human Warfighting Domain?, " *Small Wars Journal* 11, no. 12 (December 3, 2015): 1.

Much like the cyber domain, megacities, and urban centers in general, have significant physical and non-physical qualities that transcend geographic boundaries. However, as of 2016, urban warfare remains a subcomponent of the land warfare domain.[151] Subordinating cities to such a broad geographically-defined domain may be an outdated approach to warfighting in a highly interconnected global environment. Rather than adapting current land warfare doctrine to urban terrain, making megacities an operational domain will allow for the development of more focused urban doctrine and strategy. This action will also ensure that a dedicated proponent remains focused on developing and procuring the specific tools for a military intervention in megacities. Finally, establishing cities as an operational domain will allow for the creation of urban warfare related military occupational specialties.

(2) U.S. and NATO forces should develop inter-service, interagency, and international games and exercises that focus on multilateral intervention into megacities in the wake of natural or manmade disasters.

The U.S. military's chief doctrinal publication outlining Joint Operational Planning, JP 5–0, defines wargaming in the following way: "Wargaming is a conscious attempt to visualize the flow of the operation, given joint force strengths and dispositions, adversary capabilities and possible COAs, the operational area, and other aspects of the operational environment."[152]

When used consistently, wargames can increase experience and decision-making skills.[153] In the 2015 publication *Analysis of U.S. Army Preparation for Megacity Operations*, Colonel Patrick Kaune argues that wargaming megacity scenarios will, "allow the U.S. Army to generate efficiencies among the joint force and to validate

151. United States Army, *Urban Operations*, field manual no. 3-06 (Washington, DC: Headquarters, Department of the Army, 2012), par 6–31, par 7–27 to 7–33.

152. *Joint Operation Planning*, joint publication no. 5-0 (Washington, DC: U.S. Joint Chiefs of Staff, 2011), xxvii.

153. Bruce Stanley, "Wargames, Training, and Decision-Making. Increasing the Experience of Army Leaders" (master's thesis, School of Advanced Military Studies United States Army Command and General Staff College, 2000), iii.

concepts that shape and/or equip the force."[154] He also states that wargaming allows the U.S. Army to better shape its force structure for future megacity operations. Although the focus of Kaune's study is the U.S. Army, he acknowledges that military interventions in a megacity are likely to be joint, combined, and inclusive of the interagency.[155] Planners should therefore include the breath of potential partners in wargaming efforts in order to identify organizational differences and standardize response.

In the summer of 2016, the North Atlantic Treaty Organization's (NATO) Allied Command Transformation (ACT) is set to release the results of its two-year "Urbanisation Conceptual Study and Experiment." This study included participants from across academia, industry, and the militaries of 17 NATO nations with the aim of projecting the strategic implications of urbanization by the year 2035.[156] NATO ACT wargamed responses to three megacity scenarios: megacity social and political turmoil; a large-scale natural disaster; and the disruptive impact of rapid, mass migration. This experiment revealed organizational and doctrinal shortcoming within the NATO alliance. Examples include the following: the demand for real-time and dynamic, intelligence preparation of the environment (IPOE); better integration of communications platforms; and the need to integrate national urban warfare doctrines into a cohesive NATO document.[157] Undoubtedly, NATO can improve its responsiveness and relevance by continuing such wargaming experiments that focus specifically on the unique operating environment of the megacity.

In addition to wargaming, inter-service, interagency, and international exercises, such as *Talisman Saber,* put planning frameworks and intervention procedures for megacities into practice within a simulated environment. *Talisman Saber* is a biannual 20-day Humanitarian Response and Disaster Relief (HA/DR) exercise held by the U.S.

154. Patrick Kaune, *Analysis of U.S. Army Preparation for Megacity Operations* (Carlisle, PA: United States Army War College, 2016), 22.

155. Kaune, *Analysis of U.S. Army*, 22, 35.

156. "NATO Urbanisation Project," accessed May 28, 2016, http://www.act.nato.int/urbanisation.

157. "NATO Urbanisation Project."

Military and the Australian Defence Force.[158] In 2015, this exercise included participants from Japan and New Zealand for the first time.[159] Exercises such as *Talisman Saber* help identify capability gaps, improve cohesion among disparate organizations and streamline logistics during the execution of actual interventions. U.S. and NATO forces should adopt similar exercises and expand them to include megacity scenarios to better prepare for urban intervention.

(3) U.S. military and NATO forces should establish enduring relationships with civilian agencies and experts versed in the vulnerabilities and resiliencies of urban environments prior to interventions.

The 2015 U.S. National Security Strategy (NSS) acknowledges that cooperation between interagency and international partners produces strategic military success.[160] The 2015 NSS specifically mentions mayors of megacities as power brokers in this new global paradigm.[161] It is clear that megacities are gaining strategic significance, and that any successful intervention will require the full weight of civilian and military expertise.

The U.S.-based Rockefeller Foundation developed a paradigm for analyzing urban centers. In particular, it created the concept of "urban resiliencies" which are the following: "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience."[162] In their 2015 paper, "Urban Resilience" post-conflict and stabilization experts André Kahlmeyer and Milena Isakovic Suni argue that the relevant elements of urban resilience for a NATO intervention are risk reduction and assessment, infrastructure protection, training and public awareness, early warning

158. Patrick Madaj, "US Forces Practice Disaster Relief with Allies Japan and Australia," last modified August 18, 2015, accessed May 28, 2016, http://www.asiamattersforamerica.org/asia/us-forces-practice-disaster-relief-with-allies-japan-and-australia.

159. Madaj, "US Forces Practice Disaster."

160. The White House, National Security Strategy, Exec. Doc. (2015), 9–10.

161. The White House, National Security Strategy, Exec. Doc. (2015), 4.

162. "100 Resilient Cities," accessed May 28, 2016, https://www.rockefellerfoundation.org/our-work/initiatives/100-resilient-cities/.

systems, and capacities for rebuilding.[163] While the expertise needed to effectively integrate Kahlmeyer's and Suni's recommendations into military planning may lie outside of the military itself, building and formalizing relationships with civilian agencies and experts that have relevant urban expertise will make military interventions in megacities more responsive to the underlying causes of conflict. This approach should foster more rapid recovery and stabilization after an intervention.

While civilian agencies often have a wealth of expertise, they frequently lack sufficient personnel to implement plans. This is particularly true in large-scale disaster or intervention scenarios. For example, the 2010 RAND study *The U.S. Military Response to the 2010 Haiti Earthquake* notes that, while the U.S. Agency for International Development's (USAID) Office of Foreign Disaster Assistance (OFDA) had the relevant expertise to respond to this humanitarian disaster, they lacked sufficient manpower and staffing.[164] The U.S. Military augmented OFDA Disaster Assistance Response Teams (DART) with personnel and helped provide management and de-confliction for over 1,000 Non-Governmental Organizations (NGOs) operating beneath the OFDA umbrella.[165] Pre-coordinated relationships and on-the-ground cooperation between the U.S. Military and OFDA allowed USAID to fulfill its responsibility as the lead federal agency for the disaster response.[166] Combining both civilian and military expertise may be mutually beneficial to multiple organizations, while provided the most effective intervention possible.

B. CONCLUSION

In conclusion, the projected growth of existing megacities, and proliferation of new megacities in the near future, requires military planning for intervention today in order to prevent major loss of life and instability in the event of future natural or

163. Kahlmeyer, André, Milena Isakovic Suni, "Urban Resiliency, Boots of the Ground vs. Shoes on the Ground" (paper presented at NATO Urbanisation Experiment, Modelling And Simulation Centre of Excellence (M&S COE), Rome, IT, September 25, 2015), 3.

164. Gary Cecchine, *The U.S. Military Response to the 2010 Haiti Earthquake: Considerations for Army Leaders* (Santa Monica, CA: RAND, 2013), 51.

165. Cecchine, *The U.S. Military Response*, xvii.

166. Cecchine, *The U.S. Military Response*, 55.

manmade disasters. This thesis aimed to provide a general orientation to the attributes of megacities, challenges for governance of megacities, and how the unique elements of megacities can affect military planning and intervention. To help plan for intervention into megacities, the UIM model offers a tool for rapid assessment of a megacity and suggestions for what to focus on and why. While just a beginning, the UIM model should provide a useful starting point for addressing what will likely be a U.S. or NATO operation in the near future.

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APPENDIX A. MEGATRENDS, GAME CHANGERS, AND TECTONIC SHIFTS

Megatrends[167]

Individual Empowerment	Individual empowerment will accelerate owing to poverty reduction, growth of the global middle class, greater educational attainment, widespread use of new communications and manufacturing technologies, and health-care advances.
Diffusion of Power	There will not be any hegemonic power. Power will shift to networks and coalitions in a multipolar world.
Demographic Patterns	The demographic arc of instability will narrow. Economic growth might decline in "aging" countries. Sixty percent of the world's population will live in urbanized areas; migration will increase.
Food, Water, Energy Nexus	Demand for these resources will grow substantially owing to an increase in the global population. Tackling problems pertaining to one commodity will be linked to supply and demand for the others.

Game Changers[168]

Crisis-Prone Global Economy	Will global volatility and imbalances among players with different economic interests result in collapse? Or will greater multipolarity lead to increased resiliency in the global economic order?
Governance Gap	Will governments and institutions be able to adapt fast enough to harness change instead of being overwhelmed by it?
Potential for Increased Conflict	Will rapid changes and shifts in power lead to more intrastate and interstate conflicts?
Wider Scope of Regional Instability	Will regional instability, especially in the Middle East and South Asia, spill over and create global insecurity?
Impact of New Technologies	Will technological breakthroughs be developed in time to boost economic productivity and solve the problems caused by a growing world population, rapid urbanization, and climate change?
Role of the United States	Will the U.S. be able to work with new partners to reinvent the international system?

Tectonic Shifts Between Now and 2030[169]

Growth of the Global Middle Class	Middle classes most everywhere in the developing world are poised to expand substantially in terms of both absolute numbers and the percentage of the population that can claim middle-class status during the next 15–20 years.
Wider Access to Lethal and Disruptive Technologies	A wider spectrum of instruments of war—especially precision-strike capabilities, cyber instruments, and bioterror weaponry—will become accessible. Individuals and small groups will have the capability to perpetrate large-scale violence and disruption—a capability formerly the monopoly of states.
Definitive Shift of Economic Power to the East and South	The US, European, and Japanese share of global income is projected to fall from 56 percent today to well under half by 2030. In 2008, China overtook the U.S. as the world's largest saver; by 2020, emerging markets' share of financial assets is projected to almost double.
Unprecedented and Widespread Aging	Whereas in 2012 only Japan and Germany have matured beyond a median age of 45 years, most European countries, South Korea, and Taiwan will have entered the post-mature age category by 2030. Migration will become more globalized as both rich and developing countries suffer from workforce shortages.
Urbanization	Today's roughly 50-percent urban population will climb to nearly 60 percent, or 4.9 billion people, in 2030. Africa will gradually replace Asia as the region with the highest urbanization growth rate. Urban centers are estimated to generate 80 percent of economic growth; the potential exists to apply modern technologies and infrastructure, promoting better use of scarce resources.
Food and Water Pressures	Demand for food is expected to rise at least 35 percent by 2030 while demand for water is expected to rise by 40 percent. Nearly half of the world's population will live in areas experiencing severe water stress. Fragile states in Africa and the Middle East are most at risk of experiencing food and water shortages, but China and India are also vulnerable.

167. Adapted from: National Intelligence Council, *Global Trends 2030: Alternative*, ii-v, 9–12, 16–19, 21–27, 31–35.

168. Adapted from: National Intelligence Council, *Global Trends 2030: Alternative*, ii, vi-x, 51–58, 62–64, 86–98, 101–104.

169. Adapted from: National Intelligence Council, *Global Trends 2030: Alternative*, iii, v, 9, 16, 21, 27, 31, 36.

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APPENDIX B. CONSIDERATIONS FOR APPLYING THE URBAN INTERVENTION MODEL

Urban Intervention Model

Step 1 - Assess Urban Environment and Relationships
- 1.1 Identify and Prioritize Problems
- 1.2 State Desired Impacts, Outputs, or Outcomes
- 1.3 Develop Potential and Appropriate Interventions
- 1.4 Identify the Potential Effects of Interventions

Step 2 – Decide and Assign Forces
Step 3 – Intervene
Step 4 – Evaluate

Step 1 Assess Urban Environment and Relationships

The planner applies the Urban Intervention Model to inform decision making for a potential intervention in a given city. The Director of Operations directs planning priorities according to the Commander's guidance, mission, and the strategic operational environment.

Step 1.1 Identify and Prioritize Problems

a. The planner identifies problems, in the form of problem statements, for the given city that include some or all of the political, military, economic, social, information, infrastructure, physical environment, and time (PMESII-PT) factors judged as relevant in a potential intervention.
   - Problem statements should clearly capture the challenges in simple language for each key problem.
   - Problem statements should be orthogonal (distinct) to avoid duplication of problem weighting in later steps.
   - PMESII-PT should factors provide problem categories which must relate to existing problems in the given city

b. Planners select key problems that best meet mission intent and then prioritize them.
   - Key problems must directly impact the desired end state.

Cairene Case Example: First Iteration – Step 1.1
Identify Problems:

- Social: The city does not have sufficient food, water, or medical supplies to address the affected population.

- Infrastructure: The earthquake damaged the air traffic control system, rendering it inoperable. No emergency air traffic control capability exists at Cairene International Airport. There are no incoming or outgoing aircraft. Blocked roadways prevent the flow of aid and resources from Cairene International Airport into the city.

- Military: Airport security personnel are not at their posts creating risk at the airport.

Prioritize Problems:

- The J3 decides that "Infrastructure…" is the key planning problem because the airport must be operational before intervention forces can address any other key problem.

Step 1.2 State Desired Impacts, Outputs, or Outcomes

The planner concisely states desired impacts, outputs, or outcomes relative to the prioritized key problems.

Cairene Case Example: First Iteration – Step 1.2

- Infrastructure: The earthquake damaged the air traffic control system, rendering it inoperable. No emergency air traffic control capability exists at Cairene International Airport. There are no incoming or outgoing aircraft. Blocked roadways prevent the flow of aid and resources from Cairene International Airport into the city.

- The desired impact is to enable the flow of aid into the city by reestablishing emergency air traffic control as the major output. Once the international community can establish a permanent airlift into the Cairene International Airport the availability of aid on the ground will alleviate the population's needs. Having a sufficient aid supply in Cairene is the desired outcome

- Establish emergency air traffic control

- Reestablish local air traffic control capability

- Secure airport

- Open flow of aid to airport

Step 1.3 Develop Potential and Appropriate Intervention Actions

a. The planner identifies possible intervention action types that appropriately address the key problem(s) and corresponding desired impacts, outputs, or

outcomes. These action types become the measures of performance (MOPs). The MOPs are binary; they have been accomplished, or they have not been accomplished.

b. The planner conceptualizes the following details for every intervention action type in order to reduce risk for the mission and to make sure that the associated actions are in accordance with the end state and national interest:

- *Where not to do action* and *where to do action*: considers locations associated with greater risk against locations that offer greater chances of operational success

- *With whom not to do action* and *with whom to do action*: considers all options with respect to who to support and partner with, and considers which entities to avoid; these entities could be host nation security forces, civilians, NGOs, licit/illicit, et cetera

- *What not to do* and *what to do*: considers which type of activities should and should not be conducted

- *When not to do action* and *when to do action*: considers the time in which the action takes place; time in which forces, supplies, and resources can become available; duration of the action

Cairene Case Example: First Iteration – Step 1.3

Action 1: Special Tactics Teams (STT) provide emergency air traffic control:

- *Where not to do action*: non-standard runways (dirt, and or makeshift airfields)

- *Where to do action*: Cairene International Airport (confirm length of runways, identify aid storage areas; confirm noncombatant evacuation routes and staging areas)

- *With whom not to do action*: unaffiliated third party personnel to Cairene International Airport (personnel not employed or authorized to conduct operations at the airport)

- *With whom to do action*: technically experienced local nationals including, air traffic controllers, airport security personnel, technical avionics contractors, personnel whose association gives decisive access to a vital areas or objects; combined military and civilian personnel

- *What not to do*: permanently replace local air traffic controllers; introduce large numbers of external forces

- *What to do*: temporarily provide air traffic control assistance; assist with reestablishment of the local air traffic control capability; possible; ensure insertion method is appropriate for destination

- *When not to do action*: an alternative with better capabilities becomes available; Cairene no longer needs aid

- *When to do action*: provide emergency air traffic control assistance within 24 hours; upon receipt of request for assistance from Cairene

Action 2: A combination of Contingency Response Group (CRG) and of Combat Communications Group (CCG) provides emergency air traffic control systems (tower, TACAN, radar, et cetera):

- *Where not to do action*: non-standard runways (dirt, and or makeshift airfields)

- *Where to do action*: Cairene International Airport (confirm length of runways, identify aid storage areas; confirm noncombatant evacuation routes and staging areas)

- *With whom not to do action*: unaffiliated third party personnel to Cairene International Airport. (personnel not employed or authorized to conduct operations at the airport)

- *With whom to do action*: technically experienced local nationals including: air traffic controllers; airport security personnel; technical avionics contractors; personnel whose association gives decisive access to a vital areas or objects; combined military and civilian personnel

- *What not to do*: permanently replace local air traffic controllers

- *What to do*: temporarily provide air traffic control assistance; assist with reestablishment of air traffic control capability

- *When not to do action*: an alternative with better capabilities becomes available; Cairene no longer needs aid

- *When to do action*: provide air traffic control assistance within 76 hours upon receipt of request for assistance from Cairene

Action 3: TSOC remotely advises and facilitates local air traffic controllers to resume operations:

- *Where not to do action*: non-standard runways (dirt, and or makeshift airfields)
- *Where to do action*: Cairene International Airport (confirm length of runways, identify aid storage areas; confirm noncombatant evacuation routes and staging areas)
- *With whom not to do action*: unaffiliated third party personnel to Cairene International Airport (personnel not employed or authorized to conduct operations at the airport)
- *With whom to do action*: technically experienced local nationals including: air traffic controllers; airport security personnel; technical avionics contractors; personnel whose association gives decisive access to a vital areas or objects; combined military and civilian personnel
- *What not to do*: permanently replace local air traffic controllers; place U.S. personnel on the ground
- *What to do*: temporarily provide air traffic control assistance; assist with reestablishment of air traffic control capability by providing remote technical expertise through digital communications
- *When not to do action*: an alternative with better capabilities becomes available; Cairene no longer needs aid
- *When to do action*: provide air traffic control assistance within four hours, upon receipt of request for assistance from Cairene

Action 4: Contingency TSOC facilitates airdrops to deliver aid into Cairene:

- *Where not to do action*: built up locations; locations with obstacles for air delivery mechanisms
- *Where to do action*: Airport, sports fields, locations with the capacity to receive aid, or locations for storage and/or distribution

- *With whom not to do action*: illicit criminal networks that could take advantage of the aid deliveries
- *With whom to do action:* city government authorities and NGOs, which are able to control and distribute aid
- *What not to do*: permanently replace the flow the regular supply of goods through Cairenean channels
- *What to do*: temporarily deliver aid via air drop; contract civilian aircraft to airdrop aid
- *When not to do action*: better alternative aid supply sources becomes available; Cairene no longer needs aid
- *When to do action*: upon receipt of request from Cairene or upon the approval for executing airdrops, deliver airdrops as soon as possible; whenever host organizations on the ground are ready to receive the air drops

Action 5: Combat TSOC provides no direct support and only monitors the situation:

- *Where not to do action*: inside the country or Cairene
- *Where to do action*: not applicable
- *With whom not to do action*: any entity which is not related to the relief effort
- *With whom to do action*: not applicable
- *What not to do*: interfere with the supply of aid
- *What to do*: not applicable
- *When not to do action*: not applicable
- *When to do action*: not applicable

These conceptualizations highlight the relationship of intervention actions to the environment in terms of time, space, and force.

Step 1.4 Identify the Potential Effects of Interventions

The planner conceptualizes the potential effects of interventions for every action type being considered. Above, in Step 1.3, the planner conceived five action types. Therefore, the planner analyses each of the five action types to consider the potential

effects of intervention. The analysis of these effects are the measures of effectiveness (MOEs). This step produces analysis for the five action types conceived above with corresponding effects that *should* and *should not be created*.

Cairene Case Example: First Iteration – Step 1.4

J3 conceptualizes effects that should not be made and effects but instead be made per intervention action:

Action 1: Special Tactics Teams (STT) provide emergency air traffic control:

- *Effects that should not be created*: do not want to exclude local air traffic controllers from operations, even if they cannot use their equipment; do not allow local air traffic controllers to resume full control of operations until they are able to safely direct air traffic

- *Effects that should be created*: the international community and foreign militaries support Cairene´s population; should consult with local air traffic controllers to gain their knowledge for operations specific to Cairene; should identify and facilitate the equipment, expertise, and capabilities air traffic controllers need to reestablish local control of operations

- *Effects of not taking this action*: Cairene must rely upon its own resources to provide aid to the population until they are able to open the airport; international community does not supply aid or provide military forces; food and medical shortages increase rapidly in Cairene and competition over these scarce resources creates conflict in Cairene

- *Effects of taking this action*: demonstrates the international community's and foreign militaries' support to Cairene's population; immediate air traffic control operations allow a greater amount of aid to flow into Cairene within 24 hours, thus reducing human suffering; Cairene receives a sufficient amount of aid to meet the peoples' demands; competition for aid will decrease in Cairene – this may prevent escalating conflict within Cairene U.S. military assistance addresses moral and bi-lateral obligations to the affected people in Cairene; immediate air traffic control operations that open the flow of aid could avoid the spread of regional instability and supports U.S. national interest; the STT maintains a small footprint at the airport creating the impression that the U.S. military presence is not

interfering in the country's affairs, there will also be lower costs in manpower and resources for related security and sustainment operations of forces on the ground

Action 2: A combination of Contingency Response Group (CRG) and of Combat Communications Group (CCG) provides emergency air traffic control systems (tower, TACAN, radar, et cetera):

- *Effects that should not be created*: do not want to exclude local air traffic controllers from operations, even if they cannot use their equipment; do not allow local air traffic controllers to resume full control of operations until they are able to safely direct air traffic

- *Effects that should be created*: the international community and foreign militaries support Cairene´s population; should consult with local air traffic controllers to gain their knowledge for operations specific to Cairene; should identify and facilitate the equipment, expertise, and capabilities air traffic controllers need to reestablish local control of operations

- *Effects of not taking this action*: Cairene must rely upon its own resources to provide aid to the population until they are able to open the airport; international community does not supply aid or provide military forces; food and medical shortages increase rapidly in Cairene and competition over these scarce resources creates conflict in Cairene

- *Effects of taking this action*: demonstrate the international community and foreign military support to Cairene's population; air traffic control operations will allow a greater amount of aid to flow into Cairene within 72 hours, thus reducing human suffering; Cairene receives a sufficient amount of aid to meet the peoples' demands; competition for aid will decrease in Cairene – this may prevent escalating conflict within Cairene U.S. military assistance addresses moral and bi-lateral obligations to the affected people in Cairene; air traffic control operations that open the flow of aid could avoid the spread of regional instability and supports U.S. national interest; CRG and CCG maintain a large force presence at the airport – the U.S. military presence on the ground can create the impression that the U.S. is interfering in the country's affairs; this action can create an obligation to continue

operations until Cairene International Airport has restored all necessary systems to control aircraft; additional costs in manpower and resources for related security and sustainment operations of forces on the ground; if security conditions in Cairene worsen, then the associated responsibility of providing air traffic control could drag the U.S. into an unanticipated conflict

Action 3: TSOC (remotely) advises and facilitates local air traffic controllers to resume operations:

- *Effects that should not be created*: do not want to exclude local air traffic controllers from operations, nor influence local air traffic controllers to resume full control of operations until they are able to safely direct air traffic

- *Effects that should be created*: the international community and foreign militaries support Cairene´s population; should consult with local air traffic controllers to gain their knowledge for operations specific to Cairene; should identify and facilitate the equipment, expertise, and capabilities air traffic controllers need to reestablish local control of operations

- *Effects of not taking this action*: Cairene must rely upon its own resources to provide aid to the population until they are able to open the airport; international community does not supply aid or provide military forces; food and medical shortages increase rapidly in Cairene and competition over these scarce resources creates conflict in Cairene

- *Effects of taking this action*: demonstrate the international community and foreign military support to Cairene's population; Cairene is fully responsible and able to execute air traffic control operations without any foreign military presence on the ground; increased likelihood of delaying the resumption of operations at Cairene´s Airport will not provide a sufficient amount of aid to meet the total demand for aid increased miscommunications due to remote advising; there are no U.S. forces at the airport to relay situational updates for TSOC

Action 4: TSOC facilitates airdrops to deliver aid into Cairene

- *Effects that should not be created*: the airdrop should not favor any part of the city or any part of the population over

another; it should not harm civilians; it should not create increased competition for aid

- *Effects that should be created*: should airdrop aid to different locations in the city at the same time by using multiple drop zones; should maximize the amount of aid airdropped until airport is opened

- *Effects of not taking this action*: Cairene must rely upon its own resources to provide aid to the population until they are able to open the airport; international community does not supply aid or provide military forces; food and medical shortages increase rapidly in Cairene and competition over these scarce resources creates conflict in Cairene

- *Effects of taking this action*: demonstrate the international community and foreign military support to Cairene's population; airdrops may not provide a sufficient amount of aid to meet the total demand for aid; competition for access to aid will increase in Cairene – this may lead to increased conflict; U.S. military assistance addresses moral and bi-lateral obligations to the affected people in Cairene; immediate airdrop operations that open the flow of aid could avoid the spread of regional instability– supports U.S. national interest

Action 5: TSOC provides no direct support and only monitors the situation:

- *Effects that should not be created*: should not forfeit access to up-to-date information that allows an update of developing situations in Cairene

- *Effects that should be created*: Cairene is solely responsible for coordinating relief assistance and opening flows of aid; local nationals open the Cairene International Airport on their timeline; no impression of any foreign military presence on the ground

- *Effects of not taking this action*: failure to monitor the situation denies the U.S. up to date information for decision making

- *Effects of taking this action*: International community fails to provide adequate support to the suffering and greater numbers of people die; no force commitments reduce costs; monitoring conditions in Cairene are reliant upon updates

from local nationals; U.S. violates bi-lateral agreements to help Cairene during times of need

Step 2 – Decide and Assign Forces

In Step 2, *Decide and Assign Forces*, planners should carefully consider the most appropriate combination of military forces, civilian organizations, and remote support activities within the overall strategy to determine whether or not intervention should occur. Duplicity of efforts can rapidly drain finite resources. Planners should also consider all available resources to illuminate unnecessary forces and rapidly tailor sufficient intervening forces to fulfil the needs that are not able to be addressed through local resources. The impetus for Step 2 leverages existing local personnel, equipment, and resources to accomplish the mission in the shortest amount of time and with the fewest number of external resources. The final consideration, if the decision is made to intervene, should focus upon what to address given the available time, space, and forces. Once the planner identifies appropriate and distinct intervention actions, the planner then develops criteria for choosing appropriate intervention actions and conducts a pairwise comparison of the criteria and intervention alternatives using an excel Analytical Hierarchy Process (AHP) decision tool.

The AHP, a multi-attribute decision making tool, processes the consideration of multiple intervention types and multiple criteria.[170] The user can easily input changes and run new calculations and analysis.[171] Furthermore, the AHP allows a sensitivity analysis function to further analyze results. The sensitivity analysis shows the flexibility and robustness of courses of action when the criteria change, or environmental dynamics force the implementation or removal of criteria.

170. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10; Saaty, T., "An exposition of the AHP in reply to the paper Remarks on the analytical hierarchy process by JS Dyer," *Management Science*, 36, no. 3, 1990, 259–268.

171. Fox, "Multi-Attribute Decision Making &," 1–10.

Cairene Case Example: First Iteration – Step 2

The J3 develops and prioritizes criteria to evaluate intervention alternatives, and defines the following criteria for decision making:

- *Moral Obligation*: The United States has the means and the expertise to intervene, failing to do so will result in the unnecessary loss of life. Bilateral and multi-lateral international agreements require some kind of U.S. response to Cairene. An insufficient response to the disaster could harm U.S. relations abroad.

- *Capacity of Flow*: Amount of aid that can be brought to Cairene; reduced throughput capacity of life sustaining commodities such as food, water, and medical aid will cause further human suffering. Additionally, effective stabilization and recovery necessitates transportation network repair since it is an integral part resources of all type.

- *Rapid Deployment and Flexibility*: Rapid deployment will get forces on the ground faster, allowing the TSOC to build a more complete picture of what is happening. Flexibility means the military force is able to deal with currently unforeseen problems as they arise.

- *Ability to Build Capacity*: Cairenean capacity to self-recover by capitalizing on its resiliencies will speed the delivery of aid, while containing destruction in future disasters. Cairene's capacity to provide services to the people has been degraded because of the earthquake. Military forces that can help to rebuild local capacity will help stabilize long term conditions in Cairene.

- *Risk to Own Troops*: Conducting operations safely and without causing an international incident is of utmost concern for all deployments, particularly in peacetime. Planners should consider the potential loss of men, weapons, or equipment.

- *Regional Stability*: Cairene influences regional and therefore worldwide stability. Containing the effects of destruction and facilitating a rapid economic recovery may reduce regional turmoil. Rapid actions to prevent civil discontent and meet essential needs will help to stabilize Cairene.

- *Obligation versus Cost*: Long-term commitment; once committed to intervention, Cairene may expect the United

States to provide long-term assistance which can incur a high operational costs. Planners should consider which intervention forces can operate with reduced costs without incurring long-term obligations.

- *Intervention Conflict*: Being drawn into a conflict; criminal elements and their potential connection to terrorist rhetoric and networks pose the risk of drawing the U.S. forces on the ground into a conflict. The visible presence of U.S. forces in Cairene could lead to conflict within Caireen.

The planner uses judgment to weight criteria and conducts a pairwise comparison with an excel AHP decision tool.[172] Table 7 below shows how each criterion is ranked against every other criterion:

Table 7. First Iteration Criteria Pairwise Comparison

Element			More Important	Intensity (1-9)
A		B		
Moral Obligation	compared with	Capacity of Flow	A	1
		Fast Deployment/High Flexibility	A	2
		Building Capacity	A	4
		Risk to own Troops	A	5
		Regional Stability	A	6
		Obligation/High Cost	A	8
		Intervention Conflict	A	9
Capacity of Flow	compared with	Fast Deployment/High Flexibility	A	2
		Building Capacity	A	3
		Risk to own Troops	A	4
		Regional Stability	A	5
		Obligation/High Cost	A	6
		Intervention Conflict	A	7
Fast Deployment/High Flexibility	comp. with	Building Capacity	A	2
		Risk to own Troops	A	3
		Regional Stability	A	4
		Obligation/High Cost	A	5
		Intervention Conflict	A	6
Building Capacity	comp. with	Risk to own Troops	A	3
		Regional Stability	A	4
		Obligation/High Cost	A	5
		Intervention Conflict	A	6
Risk to own Troops	vs	Regional Stability	A	3
		Obligation/High Cost	A	4
		Intervention Conflict	A	5
Regional Stability	vs	Obligation/High Cost	A	2
		Intervention Conflict	A	3
Obligation/High Cost	vs	Intervention Conflict	A	2

- Note that the intensity is rated on a scale of 1 to 9 with 1 being the lowest relative importance and 9 being the highest importance.

- Table 8 below depicts the eigenvector values and ranking of criteria after the pairwise comparison has been completed:

172. Fox, "Multi-Attribute Decision Making &," 1-10.

Table 8. First Iteration Criteria Eigenvector Values and Ranking

Criterion	Eigenvector Value	Ranking
Moral Obligation	0.30	1
Capacity of Flow	0.28	2
Rapid Deployment and Flexibility	0.15	3
Building Capacity	0.10	4
Risk to Own Troops	0.07	5
Regional Stability	0.05	6
Obligation/High Cost	0.03	7
Intervention Conflict	0.03	8

- The planner weights intervention alternatives against each of the weighted criteria individually, and then conducts a second pairwise comparison.[173]
- STT: Special Tactics Teams
- CRG and CCG: Contingency Response Group (CRG) and Combat Communications Groups (CCG)
- Advise Host Nation: not responsible for air traffic control operations
- Air Drops: deliver aid without ground presence
- No Support to Intervention
- The planner identifies the prioritized ranking of alternatives against each of the eight criterion. For example, Table 9 below shows how each of the intervention types is considered against the moral obligation criteria:

173. Fox, "Multi-Attribute Decision Making &," 1-10.

Table 9. First Iteration Intervention Actions Pairwise Comparison Against Criterion – Moral Obligation

Comparison Against "Moral Obligation"			More Important	Intensity (1-9)
A		B		
STT	compared with	CRG/CCG	A	1
		Advise	A	1
		Air Drop	A	1
		No Support	A	9
CRG/CCG	compared with	Advise	A	1
		Air Drop	A	1
		No Support	A	9
Advise	comp. with	Air Drop	A	1
		No Support	A	9
Air Drop	comp. with	No Support	A	9

- The planner conducts this comparison for each of the remaining seven criteria.
- Upon completing the pairwise comparisons, the planner determines the eigenvector values for each of the intervention actions against all eight criteria, as seen in Table 10:

Table 10. First Iteration Intervention Actions, Eigenvector Values, and Ranking

Alternatives – Intervention Actions	Eigenvector Value	Ranking
CRG and CCG – Contingency Response Group (CRG) and Combat Communications Groups (CCG)	0.37	1
STT– Special Tactics Teams	0.28	2
Advise Host Nation – not responsible for air traffic control operations	0.14	3
Air Drops – deliver aid without ground presence	0.13	4
No Support	0.07	5

- The planner runs a sensitivity analysis below, in Figure 3, to better understand the robustness of the intervention actions against each of the criteria and to identify the point at which a change in criteria values yields a different recommended result:

Criterion Weights	Eigenvector Values	1	2	3	4	5
Moral Obligation	0.295465938	0.245466	0.195466	0.145466	0.095466	0.045465938
Capacity of Flow	0.276957569	0.296613	0.317663	0.340207	0.364352	0.390209209
Fast Deployment/High Flexibility	0.153845112	0.164763	0.176456	0.188979	0.202391	0.216754428
Building Capacity	0.098082774	0.105044	0.112498	0.120482	0.129033	0.138190127
Risk to own Troops	0.065694054	0.070356	0.075349	0.080697	0.086424	0.092557227
Regional Stability	0.045992112	0.049256	0.052752	0.056496	0.060505	0.0647989
Obligation/High Cost	0.034965639	0.037447	0.040105	0.042951	0.045999	0.049263554
Intervention Conflict	0.028996803	0.031055	0.033259	0.035619	0.038147	0.040853982
	Sensitivity Analysis Value:	0.05	0.05	0.05	0.05	0.05

Intervention Action Alternative Weights	Eigenvector Values					
STT	0.280361692	0.282996	0.28668	0.291489	0.297503	0.304805874
CRG/CCG	0.371218368	0.380301	0.390891	0.403095	0.417029	0.432815055
Advise	0.140147571	0.132831	0.125858	0.119254	0.113044	0.10725633
Air Drop	0.134147031	0.126405	0.118976	0.111883	0.10515	0.09880209
No Support	0.074125338	0.077468	0.081143	0.085176	0.08959	0.094414016

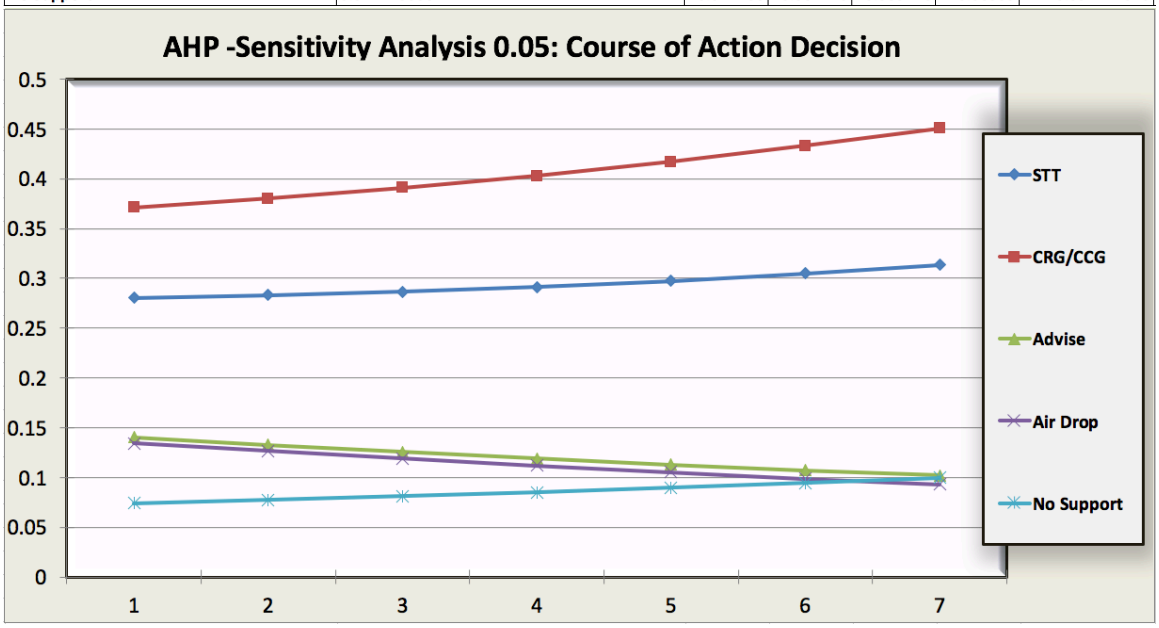

Figure 3. First Iteration AHP Sensitivity Analysis[174]

174. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10; Saaty, T., "An exposition of the AHP in reply to the paper Remarks on the analytical hierarchy process by JS Dyer," *Management Science*, 36, no. 3, 1990, 259–268.

- The 0.05 sensitivity analysis shows that the *STT* and *CRG/ CCG* remain the best suited actions if criteria change, while the *No Support* action becomes a better choice over *Advise* and *Air Drop* actions.

Planners may apply multiple attribute decision making, demonstrated in Step 2, in any step within the model where multiple alternatives must be analyzed against a set of criteria. AHP is especially useful when a diverse group with highly divergent perspectives must reach a consensus on which alternative is best. It can take any set of quantitative or qualitative data to conduct a pairwise comparison that yields an objective ranking of alternatives.

Step 3, *Intervene*, should incorporate the concepts of *what, where, with whom,* and *when* to take action. Once military forces are in the megacity, they confirm or deny the conceptualized intervention actions planned through assessments and interactions. Feedback from ground forces to higher headquarters drives updates to the common operating picture. There is ample opportunity to explore how information should be collected, analyzed, and distributed in ways that build upon the concepts presented in Chapter III and the UIM.

Step 4, *Evaluate*, planner must consider how to monitor changes in the city, how to record the changes, and how to update the common operating picture to make decisions within the intervention. The process should allow rapid fundamental changes to the concepts of *what, where, with whom,* and *when* to take (or not take) action. This step must be sufficiently robust to correct intervention actions that are in conflict with concepts of what not to do. The planner must consider how to monitor changes in the city through assessment of MOPs and MOEs, how to record the changes, and how to update the common operating picture to make decisions within the intervention. The process should allow rapid and fundamental changes to the concepts of what, where, with whom, and when to take (or not take) action. Step 4 must also be sufficiently robust to correct intervention actions which are in conflict with concepts of *what not to do*.

UIM Application: Second Iteration

Prior to *UIM Application: Iteration 1*, the TSOC J3 issued the following planning priorities to the TSOC staff:

> The desired end state is the restoration of Cairene's ability to receive and distribute aid from the international community. Any disruption of timely aid delivery or interrupted government services will likely result in local and then possibly regional security instability. Within the next 72 hours, the staff should immediately focus upon opening the flow of aid into Cairene. Once aid is flowing into Cairene, shift planning priorities to assist local security forces with stabilization. The TSOC will continue to support the U.S. Department of State once they are in the lead.

At the completion of *UIM Application: Iteration 1*, the TSOC successfully opens Cairene International Airport opening the flow of aid into the city. This enables the TSOC to transition responsibility for planning and organizing relief efforts to the Department of State, and shift priority to the city's security situation as stated in the initial planning guidance. The TSOC J3 issues the following revised planning priorities to the TSOC staff:

> Assist local and state security organizations in preventing the alliance of local criminal organizations with the regional terrorist organization. Exploit local knowledge and networks used by criminal organizations to entice them to assist Cairene officials in preventing terrorist or insurgent actions. When possible, disrupt, destroy, or neutralize the regional terrorist organization without implicating Western military forces or escalating conflicts.

The TSOC J3 directs the staff to reevaluate conditions in Cairene and initiate *UIM Application: Iteration 2*.

Step 1 Assess Urban Environment and Relationships

The planner applies the UIM to inform decision making for a potential intervention in a given city. The Director of Operations directs planning priorities according to the Commander's guidance, mission, and the strategic operational environment.

Cairene Case Example: Second Iteration – Step 1.1
Identify Problems

- *Military*: Attempting to expand its network into Cairene, a regional terrorist organization made financial offers to

criminal elements in exchange for terrorist actions. Successful terrorist attacks in Cairene will increase regional support for the terrorist organization and will increase regional instability. Their actions could incite insurgent activities. The Cairene government wants to disrupt terrorist recruitment activities.

- *Government*: Threatening rule of law, the Opposing Party sanctioned violent acts against the Ruling Party leading to the deaths of five prominent political figures. Low-level illicit activities are rampant across the city, and the criminal elements are beginning to increase the level of violence against the Ruling party members with the support of the Opposing Party. The Cairene government expressed a desire to increase its support among residents in the slums.
- *Social:* Slum dwellers want more equitable treatment from the Cairene government. Specifically, the residents in the slums want the Cairene government to provide services, and they want increased political representation from the Opposing Party.

Prioritize Problems

TSOC planners identify criminal interests in Cairene slums, Opposition Party grievances with Ruling Party members and political inequity, and growing regional terrorist influence as key problems. These problems fall under the PMESII-PT headings of Military, Social, and Government. The J3 prioritizes Government-related grievances over Military and Social, since extending rule of law into the slums will contain the spread of criminal activity across the city and deny access to terrorist organizations.

Step 1.2 State Desired Impacts, Outputs, or Outcomes

The planner concisely states desired impacts, outputs, or outcomes relative to the prioritized key problems.

Cairene Case Example: Second Iteration – Step 1.2

Government –Threatening rule of law, the Opposing Party sanctioned violent acts against the Ruling Party leading to the deaths of five prominent political figures. Low-level illicit activities are rampant across the city, and the criminal elements are

beginning to increase the level of violence against the Ruling party members with the support of the Opposing Party. The Cairene government expressed a desire to increase its support among residents in the slums.

- The desired outcome is to extend rule of law in the slums by co-opting and integrating criminal leadership into local formal governance and deny terrorist organizations access to the city. SOF cannot directly target the Opposition Party, yet the party's role is central in all emerging security threats. However, the criminal elements rely exclusively upon illicit activities to meet their financial interests. If the Cairene government can become more inclusive of the Opposition and formalize a relationship with the criminal leadership Party, there could be an opportunity to reduce security threats.

- Cairene government recognizes slums as formal residential districts; commits to improve government services to slums.

- Cairene security forces and U.S. SOF establish contact with criminal elements' leadership; create a dialogue between criminal leadership in the slums and the police and Opposition Party leadership to extend rule of law.

- The Opposition Party ceases to sanction violent acts against the Ruling Party leadership.

- The regional terrorist organization is unable to recruit Caireneans, nor conduct acts of terror in Cairene.

Step 1.3 ***Develop Potential and Appropriate Intervention Actions***

Cairene Case Example: Second Iteration – Step 1.3

Action 1: U.S. SOF advises and assists Cairene´s security forces to establish an increased presence within the slums to extend the rule of law.

- *Where not to do action*: areas with access to the police, areas under informal control but generally law abiding

- *Where to do action*: under-governed areas, which have expressed an interest in interacting with formal government entities

- *With whom not to do action:* illicit organization capable of extending security into the slums but have no interest

working with formal government entities, security forces notable for excessive corruption

- *With whom to do action*: legitimate Cairene's security forces, units with particular positive reputations
- *What not to do*: build long-term dependence on U.S. SOF to establish and maintain security
- *What to do*: place Cairene's forces in the lead for all interactions with the population
- *When not to do action*: partner forces reveal to be excessively corrupt; partner forces abuse the population; when partner forces are able to provide security without U.S. SOF assistance
- *When to do action*: within 24 hours establish contact with Cairene's security forces to begin partner force selection

Action 2: U.S. SOF brokers negotiation talks between criminal elements' leadership and the police and Opposition Party leadership to integrate slum dwellers into security and governance roles within the slums.

- *Where not to do action*: areas of the slums which are not under the control of the opposition party
- *Where to do action*: areas where the Opposition Party wields the greatest influence
- *With whom not to do action:* criminal elements unwilling to integrate with formal governments
- *With whom to do action*: Opposition Party leadership, power brokers, and informal leaders capable of leveraging public opinion in the slums
- *What not to do*: enable the Opposition Party to usurp rule of law in the slums
- *What to do*: allow Cairene government leaders to take the lead in negotiations, facilitate negotiation talks between Opposition Party and security forces
- *When not to do action*: prior to assessing legitimate actors and key leaders critical to the negotiation process

- *When to do action*: once key leaders and legitimate actors are identified

Action 3: U.S. SOF and Cairenean security forces conduct direct action operations to degrade the regional terrorist organization.

- *Where not to do action*: Built up areas where regional terrorists may use civilians for human shields
- *Where to do action*: known locations of terrorist activity with low threat to civilian population
- *With whom not to do action:* security forces notable for excessive corruption
- *With whom to do action*: legitimate Cairene's security forces, units with particular positive reputations and specific training in direct action missions
- *What not to do*: build long-term dependence on U.S. SOF to conduct adequate anti-terrorist operations
- *What to do*: place Cairene's forces in the lead for planning and executing direct actions against terrorist elements
- *When not to do action*: partner forces reveal themselves to be excessively corrupt or if OPSEC breach occurs; partner forces abuse the population when partner forces are able to conduct direct action missions without U.S. SOF assistance.
- *When to do action*: within 24 hours establish contact with Cairene's security forces to begin partner force selection

Action 4: U.S. forces only secure aid distribution networks used by the international community relief workers. All other security matters are relegated to Cairenean security forces.

- *Where not to do action*: outside any location or area where the distribution of aid takes place
- *Where to do action*: aid distribution networks (roads, supply lines) and locations that are unsafe or are related to higher risk of interruptions through offensive criminal activities
- *With whom not to do action:* security forces that are not tasked to support the relief effort

- *With whom to do action*: security forces connected to the aid distribution
- *What not to do*: secure areas that are not affiliated with the distribution of aid
- *What to do*: use of force only if criminal elements seriously disturb aid distribution
- *When not to do action*: international relief workers deny security provided by U.S. forces
- *When to do action*: international relief workers request U.S. forces to provide security, peak hours of transit and distribution

It is neither feasible nor appropriate to introduce a large external force into Cairene. Anti-western and terrorist groups could exploit the presence of large foreign military forces through their rhetoric. U.S. SOF can, however, advise local security forces on reintegrating criminal elements within municipal security and governance roles in the existing slums. SOF can also facilitate the dialogue between police and former rivals within the criminal organizations.

Step 1.4 Identify the Potential Effects of Interventions

Cairene Case Example: Second Iteration – Step 1.4

Action 1: U.S. SOF advises and assists Cairene´s security forces to establish an increased presence within the slums to extend the rule of law.

- *Effects that should not be created*: cause Cairene's population lose confidence in city security forces, alienate marginal population with growing interests in interacting with formal government entities, empower Cairene's security forces to exercise excessive corruption, enable Cairene's security forces to abuse the population
- *Effects that should be created*: build confidence in Cairene's forces by appropriate show of force, enable Cairene's forces to become visible to the population and to extend rule of law into the slums, enable Cairene's forces to conduct security operation without requiring the assistance of U.S. SOF, build legitimacy for Cairene's government in under governed areas of the city

- *Effects of not taking this action*: Cairene's forces will not increase capacity or capability; Cairene's forces may continue to neglect the slum, criminal network continue to spread influence within the slum; Criminal networks are enabled to project power beyond the slums and to areas traditionally governed by rule of law.

- *Effects of taking this action*: U.S. demonstrates resolve and commitment to Cairene government and security forces; U.S provides appropriate mentorship to security forces; U.S. fulfils obligations to assist the people of Cairene; U.S. safeguards national and regional interest by containing rising instability within the city.

Action 2: U.S. SOF brokers negotiation talks between criminal elements' leadership and the police and Opposing Party leadership to integrate slum dwellers into security and governance roles within the slums.

- *Effects that should not be created*: cause Cairene's population lose confidence in city security forces, alienate marginal population with growing interests in interacting with formal government entities, empower Cairene's police forces to exercise excessive corruption by adopting illicit practice, create the perception that Cairene´s government loses control of the situation

- Effects that should be created: Cairene's government opens a direct line of communication to Opposition Party and criminal elements, builds confidence in Cairene's forces by demonstrating interest in slum population, enables Cairene's government to become visible to the population, and enable Cairene's forces to gain insight slum population grievances, build legitimacy for Cairene's government in under governed areas of the city.

- *Effects of not taking this action*: Cairene's forces will not gain insight in the grievances of the slum population; Cairene's government may continue to neglect the slum; criminal network continue to spread influence within the slum; criminal networks are enabled to project power beyond the slums and to areas traditionally governed by rule of law.

- *Effects of taking this action*: Cairene government demonstrates resolve and commitment to slum population; U.S provides appropriate mentorship for negotiations; U.S.

fulfils obligations to assist the people of Cairene; U.S. safeguards national and regional interest by containing rising instability within the city

Action 3: U.S. SOF and Cairenean security forces conduct direct action operations to degrade the regional terrorist organization.

- *Effects that should not be created*: build long-term dependence on U.S. SOF to conduct direct action missions; anti-terrorism operations take precedence over, and become disassociated from long-term relief and stability efforts; alienate population by misapplication of force; disrupt long term relief efforts by creating collateral damage

- *Effects that should be created*: disrupt and dismantle terrorist networks operating in Cairene, contain the spread of regional terrorism, de-legitimize terrorist networks and their affiliates, build confidence in Cairene's forces by appropriate show of force, enable Cairene's forces, enable Cairene's forces to conduct direct action operations without requiring the assistance of U.S. SOF, build legitimacy for Cairene's government and direct action security forces

- *Effects of not taking this action*: Terrorist networks may proliferate across the region, terrorist networks may gain legitimacy and influence within Cairene, Cairene's forces unable to project governance into the slums, criminal network continue to spread influence within the slum, criminal networks are enabled to project power beyond the slums and to areas traditionally governed by rule of law

- *Effects of taking this action*: U.S. demonstrates resolve and commitment to Cairene government and security forces, U.S provides appropriate mentorship to security forces, U.S. fulfils obligations to assist the people of Cairene, U.S. safeguards national and regional interest by containing rising instability within the city

Action 4: U.S. forces only secure aid distribution networks used by the international community relief workers. All other security matters are relegated to Cairenean security forces.

- *Effects that should not be created*: Criminal networks create illegitimate distribution sites for pilfered commodities away from aid distribution sites; international community relief workers only operate in the most highly secure areas; Cairene's security forces become

overwhelmed by problems and fail to adequately address security matters not related to the distribution of aid

- *Effects that should be created*: International community relief workers are confident in the U.S. forces ability to secure relief efforts; Necessary aid is distributed in a timely manner; No pilferage, theft or hijacking occurs along aid distribution networks; Distribution of aid is regulated, streamlined, and orderly; Cairene's security forces have a manageable set of security related responsibilities.

- *Effects of not taking this action*: Pilferage, theft and hijacking are likely to occur along the aid distribution network; Aid workers may refuse to deliver aid; Cairene's security forces become overwhelmed and unable to effectively secure distribution routes or fulfill other security related responsibilities; Aid is not delivered in a timely fashion causing increased instability.

- *Effects of taking this action*: U.S. demonstrates resolve and commitment to Cairene's government and international relief organizations; U.S provides minimal but adequate assistance to relief workers, enabling the effective distribution of aid; U.S. fulfils obligations to assist the people of Cairene; U.S. safeguards national and regional interest by containing rising instability within the city

Step 1.4 *Identify the Potential Effects of Interventions* considers the effects of each intervention action and determines that Western military presence should be kept as minimal and as discrete as possible. Higher-level political discussions with the Opposition Party and Ruling Party should remain within Department of State channels, while continued dialogue between local security officials and criminal leaders should continue. Joint U.S. and local HUMINT efforts should focus upon identifying Cairene sources of support of the regional terrorist organization. Further identification will allow lethal and non-lethal targeting by host nation and coalition forces.

Step 2 – Decide and Assign Forces

Cairene Case Example: Second Iteration – Step 2

The J3 develops and prioritizes criteria to evaluate intervention alternatives, and defines the following criteria for decision making:

- *Risk to Own Troops*: Conducting operations safely and without causing an international incident is of utmost concern for all deployments, particularly in peacetime. Planners should consider the potential loss of men, weapons, or equipment.

- *Regional Stability*: Cairene influences regional and therefore worldwide stability. Containing the effects of destruction and facilitating a rapid economic recovery may reduce regional turmoil. Rapid actions to prevent civil discontent and meet essential needs will help to stabilize Cairene.

- *Ability to Build Capacity*: Cairenean capacity to self-recover by capitalizing on its resiliencies will speed the delivery of aid, while containing destruction in future disasters. Cairene's capacity to provide services to the people has been degraded because of the earthquake. Military forces that can help to rebuild local capacity will help stabilize long term conditions in Cairene.

- *Disrupt Terrorist Activities*: U.S. and host nation security forces should disrupt, destroy, or neutralize the regional terrorist organization without implicating Western military forces or escalating conflicts. Security forces should disrupt the possible alliance of local criminal organizations with the regional terrorist organization.

- *Moral Obligation*: The United States has the means and the expertise to intervene, failing to do so will result in the unnecessary loss of life. Bilateral and multi-lateral international agreements require some kind of U.S. response to Cairene. An insufficient response to the disaster could harm U.S. relations abroad.

- *Intervention Conflict*: Being drawn into a conflict; criminal elements and their potential connection to terrorist rhetoric and networks pose the risk of drawing the U.S. forces on the ground into a conflict. The visible presence of U.S. forces in Cairene could lead to conflict within Caireen.

- *Obligation versus Cost*: Long-term commitment; Once committed to intervention, Cairene may expect the U.S. to provide long-term assistance which can incur a high operational costs. Planners should consider which

intervention forces can operate with reduced costs without incurring long-term obligations.

- *Capacity of Flow*: Amount of aid that can be brought to Cairene; reduced throughput capacity of life sustaining commodities such as food, water, and medical aid will cause further human suffering. Additionally, effective stabilization and recovery necessitates transportation network repair since it is an integral part resources of all type.

The planner uses judgment to weight criteria and conducts a pairwise comparison with an excel AHP decision tool.[175] Table 11 below shows how each criterion is ranked against every other criterion:

Table 11. Second Iteration Criteria Pairwise Comparison

Element			More Important	Intensity (1-9)
A		B		
Risk to Own Troops	compared with	Regional Stability	A	3
		Ability to Build Capacity	A	4
		Disrupt Terrorist Activities	A	5
		Moral Obligation	A	5
		Intervention Conflict	A	7
		Obligation versus Cost	A	8
		Capacity of Flow	A	8
Regional Stability	compared with	Ability to Build Capacity	A	2
		Disrupt Terrorist Activities	A	3
		Moral Obligation	A	4
		Intervention Conflict	A	6
		Obligation versus Cost	A	7
		Capacity of Flow	A	8
Ability to Build Capacity	comp. with	Disrupt Terrorist Activities	A	1
		Moral Obligation	A	4
		Intervention Conflict	A	5
		Obligation versus Cost	A	6
		Capacity of Flow	A	4
Disrupt Terrorist Activities	comp. with	Moral Obligation	A	1
		Intervention Conflict	A	2
		Obligation versus Cost	A	4
		Capacity of Flow	A	5
Moral Obligation	vs	Intervention Conflict	A	3
		Obligation versus Cost	A	5
		Capacity of Flow	A	1
Intervention Conflict	vs	Obligation versus Cost	A	1
		Capacity of Flow	A	3
Obligation versus Cost	vs	Capacity of Flow	A	4

- Note that the intensity is rated on a scale of 1 to 9 with 1 being the lowest relative importance and 9 being the highest importance.

- Table 12 below depicts the eigenvector values and ranking of criteria after the pairwise comparison has been completed:

175. Fox, "Multi-Attribute Decision Making &," 1-10.

Table 12. Second Iteration Criteria, Eigenvector Values, and Ranking

Criterion	Eigenvector Value	Ranking
Risk to Own Troops	0.42	1
Regional Stability	0.19	2
Ability to Build Capacity	0.12	3
Disrupt Terrorist Activities	0.09	4
Moral Obligation	0.07	5
Intervention Conflict	0.04	6
Obligation versus Cost	0.04	7
Capacity of Flow	0.04	8

- The planner weights intervention alternatives against each of the weighted criteria individually, and then conducts a second pairwise comparison:[176]

- *Action 1* – U.S. SOF advises and assists the Cairene security forces to establish an increased presence within the slums to extend the rule of law.

- *Action 2* – U.S. SOF brokers negotiation talks between criminal elements' leadership and the police and Opposition Party leadership to integrate slum dwellers into security and governance roles within the slums.

- *Action 3* – U.S. SOF and Cairenean security forces conduct direct action operations to degrade the regional terrorist organization.

- *Action 4* – U.S. forces only secure aid distribution networks used by the international community relief workers. All other security matters are relegated to Cairenean security forces.

The planner identifies the prioritized ranking of alternatives against each of the eight criterion. For example, Table 13 below shows how each of the intervention types is considered against the regional stability criterion:

176. Fox, "Multi-Attribute Decision Making &," 1-10.

Table 13. Second Iteration Intervention Actions Pairwise Comparison Against Criterion – Regional Stability

Comparison Against "Regional Stability"				
A		B	More Important	Intensity (1-9)
Action 1	compared with	Action 2	B	3
		Action 3	A	2
		Action 4	A	8
Action 2	compared with	Action 3	A	5
		Action 4	A	8
Action 3	comp. with	Action 4	A	7

- The planner conducts this comparison for each of the remaining seven criteria.

Upon completing the pairwise comparisons, the planner determines the eigenvector values for each of the intervention actions against all eight criteria, as seen in Table 14 below:

Table 14. Second Iteration Intervention Actions, Eigenvector Values, and Ranking

Alternatives – Intervention Actions	Eigenvector Value	Ranking
***Action 1*:** U.S. SOF advises and assists the Cairene security forces to establish an increased presence within the slums to extend the rule of law.	0.33	2
Action 2: U.S. SOF brokers negotiation talks between criminal elements' leadership and the police and Opposition Party leadership to integrate slum dwellers into security and governance roles within the slums.	0.38	1
Action 3: U.S. SOF and Cairenean security forces conduct direct action operations to degrade the regional terrorist organization.	0.16	3
Action 4: U.S. forces only secure aid distribution networks used by the international community relief workers. All other security matters are relegated to Cairenean security forces.	0.12	4

- The planner runs a sensitivity analysis below, in Figure 4, to better understand the robustness of the intervention

actions against each of the criteria and to identify if there is a point at which changes in criteria values yield a different recommended result:

Eigenvector Criterion Weights	Eigenvector Values	1	2	3	4	5
Risk to Own Troops	0.418515773	0.368516	0.318516	0.268516	0.218516	0.168515773
Regional Stability	0.185510133	0.201462	0.218785	0.237597	0.258027	0.28021442
Ability to Build Capacity	0.118996813	0.129229	0.140341	0.152408	0.165514	0.179745561
Disrupt Terrorist Activities	0.085114006	0.092433	0.100381	0.109012	0.118386	0.128565331
Moral Obligation	0.070837649	0.076929	0.083544	0.090727	0.098529	0.107000789
Intervention Conflict	0.044702212	0.048546	0.05272	0.057254	0.062177	0.06752302
Obligation versus Cost	0.039053497	0.042412	0.046058	0.050019	0.05432	0.058990594
Capacity of Flow	0.037269917	0.040475	0.043955	0.047734	0.051839	0.056296484
	Sensitivity Analysis Value:	0.05	0.05	0.05	0.05	0.05

Final Results	Eigenvector Values					
Action 1	0.331873563	0.325673	0.320676	0.316987	0.314717	0.313988261
Action 2	0.381453454	0.379209	0.378523	0.379531	0.382378	0.387221447
Action 3	0.1626551	0.169383	0.177052	0.185743	0.195545	0.206551984
Action 4	0.124017883	0.125736	0.128048	0.131007	0.134668	0.139090279

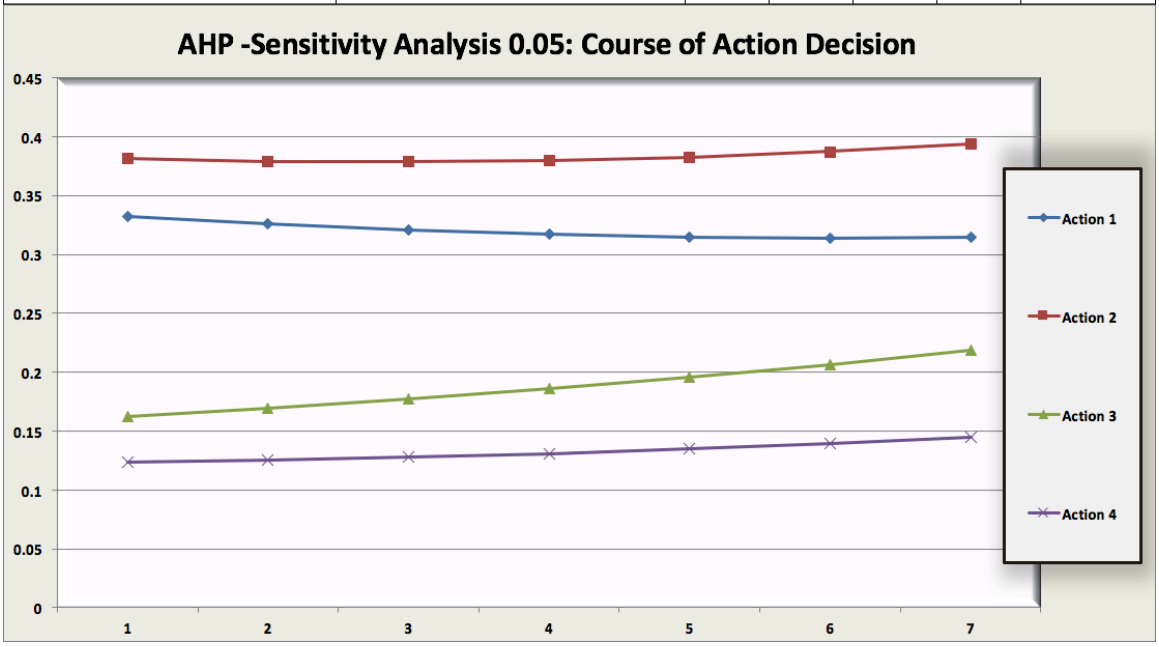

Figure 4. Second Iteration AHP Sensitivity Analysis[177]

- The 0.05 sensitivity analysis shows that *Action 1* and *Action 2* are the best suited actions if criteria change, while *Action 3* and *Action 4* are more susceptible to rapid changes in Cairene.

177. William P. Fox, "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and TOPSIS, DA 4410" (working paper, Naval Postgraduate School, Monterey, CA, June 2015), 1-10; Saaty, T., "An exposition of the AHP in reply to the paper Remarks on the analytical hierarchy process by JS Dyer," *Management Science*, 36, no. 3, 1990: 259–268.

As SOF continue operations in Step 3 *Intervene*, each action is informed by the planning process to include *with whom to act or not act, what action to take or not take, when to act or not act,* and *where to act or not act*. As a result, rapid decision making, a function of Step 2 *Decide and Assign Forces*, allows forces to counter widespread criminal activities, politically backed killings, and terrorist support actions. SOF further determines that continued low-level looting provides sufficient pre-occupation and income to criminal organizations, therefore giving criminal elements less incentive to partner with the terrorist organization. As the dialogue between the criminal elements and municipal government continues, several indigenous criminal leaders express interest in cooperating with the government while most immigrant criminal leaders refuse any communication.

Upon evaluating intervention actions in Step 4 *Evaluate,* the J3 decides to foster ongoing SOF-sponsored reintegration dialogues between select criminal elements and Cairene police. Regional state partners offer to provide a military response to the terrorist activity in Cairene. The collaborative approach will reduce Western military presence, but the TSOC will facilitate intelligence sharing between regional partners. The Department of State works with government officials to broker a deal to bring no charges against the Opposition Party if politically motivated killings stop.

The J3 determines that the intervention actions have opened the flow of aid to Cairene and assisted local security forces in maintaining security and rule of law in Cairene. The TSOC provided leadership, planning, and resource assistance to the government to address human suffering and security concerns. The TSOC also determines that a small advise and assist SOF presence is sufficient to maintain enduring support to Cairene's civil administration.

UIM Parallel Planning Considerations

The application of the UIM to a highly specific case, like Cairene, demonstrates how each step in the model progresses. It does not highlight the parallel planning that occurs among other staff sections (J2, J3, J4, et cetera). In practice, however, every staff section would generate staff planning estimates using the UIM according to its roles,

mission, or perspectives. For these reasons, Figure 5 depicts how to plug in *n* number of models, horizontally and vertically. It demonstrates how parallel planning estimates (conceptualizations) address *where, when, how, and why* the flow of aid moves from input locations, through networks, to destinations (processes or actions). Each horizontal planning estimate should be constantly evaluated against the mission and the desired end state through feedback mechanisms. The change in the center of gravity (COG) from the first iteration to subsequent iterations can highlight how parallel planning from all staff sections contribute to the overall understanding and operation in subsequent time periods. Furthermore, Figure 5 shows how to incorporate other key problems like communications or economics that planners do not assess as COGs. The UIM allows a holistic approach and systematically tackles the complex environment of a megacity. It also connects planning estimates with a greater number of factors to identify dependencies and causalities.

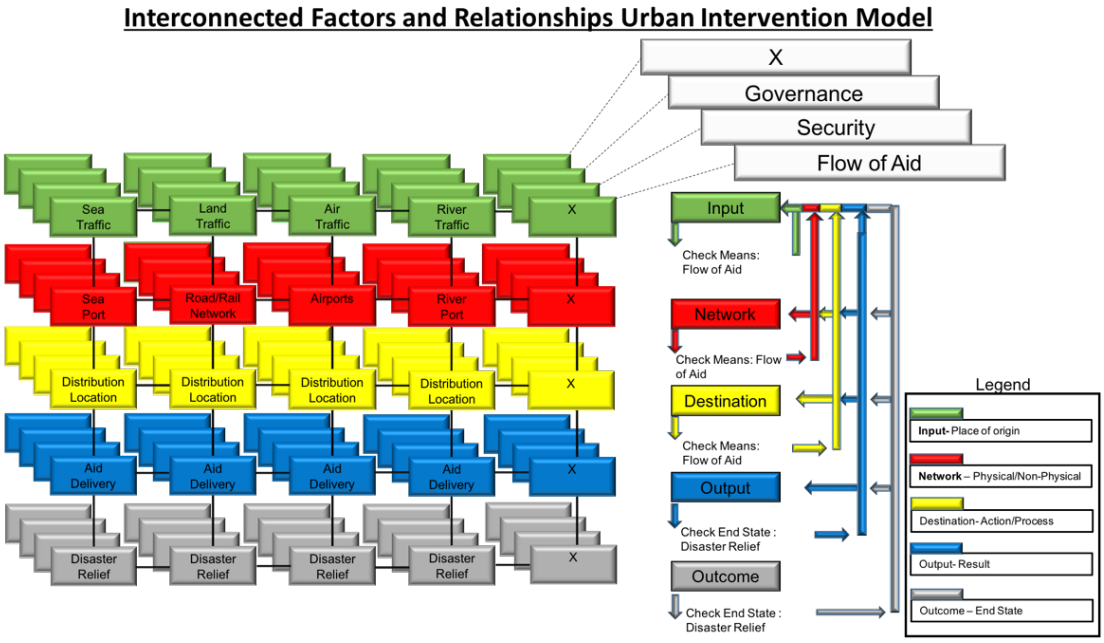

Figure 5. Urban Intervention Model – Interconnected Factors and Relationships

Each step of the model builds upon the next step. By expanding acceptable intervention types, using concepts of *who, where, what, and when,* the model rapidly brings many factors together without considering each factor individually or their

relationships to other factors. Expanding acceptable intervention actions allows the rapid and passive consideration of the associated factors which is based on information gained in previous steps. Active consideration in subsequent steps also allows the planner to return to any previous step and make adjustments. The feedback mechanism facilitates flexible planning in environments when dynamics change rapidly, such as in megacities. This then allows the consideration of possible effects of interventions against the host of factors accounted for in all previous steps. If a planner moves backwards in any step to make adjustments or corrections, then the planner must continue in sequential order to account for changed variables in previous steps. A key benefit of the UIM is its simplicity and speed of application that enables both military and civilians to understand and apply the model. All of these qualities enhance military interventions that closely cooperate with the interagency and host nation planners. There is not a prescribed "right" or "wrong" manner to answer the questions; instead, it is creativity and open-mindedness that creates resilient responses in megacities.

LIST OF REFERENCES

"100 Resilient Cities." Accessed May 28, 2016. https://www.rockefellerfoundation.org/our-work/initiatives/100-resilient-cities/.

Aganivanshi, Jepranshu. "The Urban Progression, Dhaka: The Most Densely Inhabited Megacity." urbanfailure.blogspot.com. Last modified May 22, 2014. Accessed March 16, 2015. http://urbanfailure.blogspot.com/2014/05/dhaka-most-densely-inhabited-megacity.html.

Air Pollution: World's Worst Environmental Health Risk. Technical report no. 2014. UNEP Year Book 2014 emerging issues update 2014. Geneva, Switzerland: United Nations Environment Programme, n.d.

Ambrose, Stephen E., and Douglas Brinkley. *Rise to Globalism: American Foreign Policy since 1938*. 8th ed. New York: Penguin Books, 1997.

Anderson, T., Dolk, D., and Busalacchi, F., Network Certication of GINA and Development of CONOPs for the GINA Tunnel System," Tech. Rep. TRAC-M-TR-13-003, TRADOC Analysis Center, Monterey, CA (2012).

Anderson, T, Blais, C., Brutzman, D., and McKenzie, S., Geospatial Mapping of Internet Protocol Addresses for Real-Time Cyber Domain Visual Analytics and Knowledge Management Using the Global Information Network Architecture," NCIJ 1 (2) (2014).

Anderson, Thomas, William Platte, Frank Busalacchi, and David Tinsley. "Vector Relational Data Modeling (VDRM) and Global Information Network Architecture (GINA)." Contribution to the "Conceptual Modeling in Megacities Conference" symposium conducted at TRADOC Analysis Center, Monterey, CA, March 8, 2016.

Andregg, Michael. *Seven Billion and Counting: The Crisis in Global Population Growth*. Minneapolis: Twenty-First Century Books, 2014.

Arquilla, John, and Douglas A. Borer. *Information Strategy and Warfare: A Guide to Theory and Practice*. New York: Routledge, 2007.

Art, Robert J., and Kenneth N. Waltz. *The Use of Force: Military Power and International Politics*. 5th ed. Lanham, Md.: Rowman & Littlefield, 1999.

Ascher, Kate, and Wendy Marech. *The Works: Anatomy of a City*. New York: Penguin Press, 2005.

Baldwin, David A. *Neorealism and Neoliberalism: The Contemporary Debate*. New York: Columbia University Press, 1993.

Barber, Benjamin R. *If Mayors Ruled the World: Dysfunctional Nations, Rising Cities*. New Haven: Yale University Press, 2013.

Bardi, Ugo. *The Limits to Growth Revisited*. New York: Springer, 2011.

Batschelet, Allen. *Effects-based operations: A new Operational Model?* USAWC Strategy Research Project. Carlisle Barracks, PA: U.S. Army War College, 2002.

Batty, Michael. *The New Science of Cities*. Cambridge, MA: MIT Press, 2013.

Bejan, Adrian, and J. Peder Zane. *Design in Nature: How the Constructal Law Governs Evolution in Biology, Physics, Technology, and Social Organization*. New York: Doubleday, 2012.

Bouton, Shannon, David Cis, Lenny Mendonca, Herbert Pohl, Jaana Remes, Henry Ritchie, and Jonathan Woetzel. *How to Make a City Great, a Review of the Steps City Leaders around the World Take to Transform Their Cities into Great Places to Live and Work*. N.p.: McKinsey & Company, 2013.
McKinsey & Company is a global management consulting firm (http://www.mckinsey.com/insights/urbanization/how_to_make_a_city_great).

Brown, James H., and Geoffrey B. West. *Scaling in Biology*. New York: Oxford University Press, 2000.

Brueckner, Jan K. *Lectures on Urban Economics*. Cambridge, Mass.: MIT Press, 2011.

Buijs, Steef, Wendy Wanyin Tan, Devisari Tunas, and George Brugmans. *Megacities: Exploring a Sustainable Future*. Rotterdam: 010 Publishers, 2010.

Burden of Disease from Ambient Air Pollution for 2012. Technical report no. 2014. Public Health, Social and Environmental Determinants of Health Department 2014. Geneva, Switzerland: World Health Organization, 2014.

Burden of Disease from Household Air Pollution for 2012. Public Health, Social and Environmental Determinants of Health Department 2014. Geneva, Switzerland: World Health Organization, 2014.

Burden of Disease from Joint Household and Ambient Air Pollution for 2012. Technical report no. 2014. Public Health, Social and Environmental Determinants of Health Department 2014. Geneva, Switzerland: World Health Organization, 2014.

Busalacchi, F., Tinsley, D., Skinner, W., Bressler, P., and Yarbrough, E., "Global information network architecture." Google Patents (March 2010).

Butler, James P. "Godzilla Methodology, Means for Determining Center of Gravity." *Joint Forces Quarterly* 72 (1st Quarter 2014): 26–30.

Campanella, Jack. *Principles of Quality Costs: Principles, Implementation and Use*. 3rd ed. Milwaukee, Wis.: ASQ Quality Press, 1999.

Cecchine, Gary. *The U.S. Military Response to the 2010 Haiti Earthquake: Considerations for Army Leaders*. Santa Monica, CA: RAND, 2013.

Chakrabarti, Vishaan. *A Country of Cities: A Manifesto for an Urban America*. New York: Metropolis Books, 2013.

Chandrasekaran, B., John R. Josephson, and Richard Benjamins. "What are ontologies, and why do we need them?" *IEEE Intelligent Systems and their Applications* 14, no. 1 (January 1999): 20–26. DOI: 10.1109/5254.747902; This publication ceased production in 2000. The current retitled publication is IEEE Intelligent Systems.

Chaudhuri, Rudra, and Theo Farrell. "Campaign Disconnect: Operational Progress and Strategic Obstacles in Afghanistan, 2009–2011." Abstract. *International Affairs* 87, no. 2 (March 2011): 271–96.

Chennamaneni, Ramesh, and Subba Rao. *Assessment of Urban Carrying Capacity: A Case Study of Environmental and Institutional Implications for Water Resource Management in Hyderbad*. Research report no. 8. Research for the Sustainable Development of the Megacities of Tomorrow. Berlin, Germany: Federal Ministry of Education and Research (BMBF), n.d.

Chief of Staff of the Army, Strategic Studies Group, Megacities Concept Team, Megacities and the United States Army: Preparing for a Complex and Uncertain Future, Rep. (2014).
Colonel Marc Harris, Lieutenant Colonel Robert Dixon, Major Nicholas Melin, Command Sergeant Major Daniel Hendrex, Sergeant Major Richard Russo, and Mr. Michael Bailey were all contributing authors. Arlington, VA.

Clancy, James, and Chuck Crossett. "Measuring Effectiveness in Irregular Warfare." *Parameters* XXXVII, no. 2 (Summer 2007): 88–100.

Clark, Clinton R., and Timothy J. Cook. "A Practical Approach to Effects-Based Operational Assessment." *Air and Space Power Journal* XXII, no. 2 (June 1, 2008).

Clausewitz, Carl von, Michael Howard, and Peter Paret. *On War*. Princeton, N.J.: Princeton University Press, 1976.

The Commonwealth of Australia The Australian Army. *The Australian Army in the Urban, Networked Littoral*. By David Kilcullen. Army Research Paper no. 2. Russell Defence Offices, A.C.T.: Directorate of Future Land Warfare, 2014.

Connable, Ben. *Embracing the Fog of War: Assessment and Metrics in Counterinsurgency*. Santa Monica, CA: RAND, 2012.

Corrin, Amber. "Sensory Overload: Military Is Dealing with a Data Deluge." *FCW: The Business of Federal Technology*, February 4, 2010.

Cox, Wendell. *Demographia World Urban Areas, 11th Annual Edition*. Demographia World Urban Areas 2015:01. Belleville, IL: Wendell Cox Consultancy, 2015. http://www.demographia.com/db-worldua.pdf

———. "Evolving Urban Form: Dhaka." New Geography. Last modified August 8, 2012. Accessed January 27, 2016. http://www.newgeography.com/content/003004-evolving-urban-form-dhaka.

Daly, Herman E. *Beyond Growth: The Economics of Sustainable Environment*. Boston, Mass.: Beacon Press, 1996.

Davis, Mike. *Planet of Slums*. London: Verso, 2006.

Demarest, Geoff. *Property & Peace, Insurgency, Strategy and the Statute of Frauds*. Fort Leavenworth, KS: Foreign Military Studies Office, n.d.

———. *Property & Peace: Insurgency, Strategy and the Statute of Frauds*. Fort Leavenworth, KS: Foreign Military Studies Office, n.d.
FMSO is an open-source research and analysis center using foreign language publications and contacts to stay abreast of military developments outside of the USA.

Department of the Army, *Special Operations (*ARDP 3_05), 31 August 2012, Washington, DC, V.

Doherty, Thomas. "Should There Be a Human Warfighting Domain?" *Small Wars Journal* 11, no. 12 (December 3, 2015).

Dolk, D., Anderson, T., Busalacchi, F., and Tinsley, D., GINA: System Interoperability for Enabling Smart Mobile System Services in Network Decision Support Systems," in [2012 45th Hawaii International Conference on System Science (HICSS)], 1472{1481, IEEE (2012).

Dombrowsk, Peter, and Chris Demchak. “Cyber War, Cybered Conflict, and the Maritime Domain.” *Naval War College Review* 67, no. 2 (Spring 2014): 72–96.

Doytsher, Yerach, Paul Kelly, Rafic Khoury, Robin McLaren, Harmut Mueller, and Chryssy A. Potsiou. *Rapid Urbanization and Mega Cities: The Need for Spatial Information Management : Research Study*. Edited by Chryssy A. Potsiou. FIG Report 48. Copenhagen, Denmark: International Federation of Surveyors (FIG), 2010.

Echevarria, Antulio J., II. *Clausewitz’s Center of Gravity: Changing Our Warfighting Doctrine- Again!* Report no. 1–58487-099-0. Carlisle, PA: Strategic Studies Institute, 2002. U.S. Army War College, Carlisle PA.

Eikmeier, Dale C. “Design for Napoleon’s Corporal.” *Small Wars Journal*, September 27, 2010.

———. “Design Versus the Center of Gravity.” *Small Wars Journal*, March 28, 2012.

El Dahshan, Mohamed. “Developing World’s Megacities Struggle to Conserve Water.” *Egypt Independent* (Cairo, Egypt), December 9, 2010, Online edition. http://www.egyptindependent.com/news/developing-world’s-megacities-struggle-conserve-water.

Elkus, Adam. “A Critical Perspective on Operational Art and Design Theory.” *Small Wars Journal*, April 30, 2012.

Evans, Michael. “Megacities: Pros and Cons, The Case Against Megacities.” *Parameters* 45, no. 1 (Spring 2015): 33–43.

Felix, Kevin M., and Frederick D. Wong. “Megacities: Pros and Cons, The Case for Megacities.” *Parameters* 45, no. 1 (Spring 2015): 19–32.

Finnemore, Martha. *National Interests in International Society*. Ithaca, N.Y.: Cornell University Press, 1996.

“The First Global South International Studies Conference.” In *Global South Graphic*, compiled by Imad Mansour. Menton, France: International Studies Association, 2012. accessed January 18, 2016, http://gscis.blogspot.com/2012/09/the-first-global-south-international.html

Florida, Richard L. *The Rise of the Creative Class, Revisited*. New York: Basic Books, 2012.

———. *Who’s Your City?: How the Creative Economy Is Making Where to Live the Most Important Decision of Your Life*. New York: Basic Books, 2008.

Food and Agriculture Organization of the United Nations. *World Agriculture: Towards 2015/2030 Summary Report*. Rome, Italy: Food and Agriculture Organization of the United Nations, 2002.

Fox, William P. "Multi-Attribute Decision Making & Mathematical Modeling for Decision Making, AHP and Topsis, DA 4410." Working paper, Naval Postgraduate School, Monterey, CA, June 2015.

Friedman, Thomas L. *The World Is Flat: A Brief History of the Twenty-first Century*. New York: Farrar, Straus and Giroux, 2005.

Glaeser, Edward L. *Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*. New York: Penguin Press, 2011.

"The Global Information Network Architecture™ Environment (GINA™)." BKT, Next Gen Computational Design. Accessed April 17, 2016. http://new.bigkahunatech.com/.

Global Trends 2030: Alternative Worlds : a Publication of the National Intelligence Council. December 2012.: National Intelligence Council, 2012.

Goldsmith, Stephen, and Susan P. Crawford. *The Responsive City: Engaging Communities through Data-smart Governance*. San Francisco: Jossey-Bass, 2014.

Graham, Stephen. *Cities under Siege: The New Military Urbanism*. Pbk. ed. London: Verso, 2011.

Greaver, Bradley, and Leo Raabe. "CARVER 2.0: Integrating AHP with Center of Gravity Vulnerability Analysis." Working paper, Naval Postgraduate School, Monterey, CA, September 2015.

Greenspan, Alan. *The Map and the Territory: Risk, Human Nature, and the Future of Forecasting*. New York: The Penguin Press, 2013.

Gruninger, Michael, and Jintae Lee. "Ontology – Applications and Design." *Communications of the ACM* 45, no. 2 (February 2002): 39–41.

Guarino, Nicola. *Formal Ontology in Information Systems: Proceedings of the First International Conference (FOIS'98), June 6–8, Trento, Italy*. Amsterdam: IOS Press, 1998.

Haas, Rainer, and Oliver Meixner. *An Illustrated Guide to the Analytical Hierarchy Process*. Vienna, Austria: Institute of Marketing & Innovation University of Natural Resources and Applied Life Sciences, Vienna, n.d.

Hallam, David, comp. *Food Outlook Biannual Report on Global Food Markets*. Technical report no. 2014. Food and Agriculture Organization of the United Nations 20014. Rome, Italy: Trade and Market Division, Food and Agriculture Organization, Global Information and Early Warning System, 2014.

Harrison, John, and Michael Hoyler. *Megaregions: Globalization's New Urban Form?* Cheltenham, UK: Edward Elgar, 2015.

Harvey, David. *A Brief History of Neoliberalism*. Oxford: Oxford University Press, 2005.

———. *Rebel Cities: From the Right to the City to the Urban Revolution*. New York: Verso, 2012.

Heinberg, Richard. *The End of Growth: Adapting to Our New Economic Reality*. Gabriola Island, B.C.: New Society, 2011.

Herndon, Robert, John Robinson, James Creighton, Raphael Torres, and Louis Bello. "Effects-Based Operations in Afghanistan The CJTF-180 Method of Orchestrating Effects to Achieve Objectives." *Field Artillery*, January/February 2004.

Hills, Alice. *Future War in Cities: Rethinking a Liberal Dilemma*. London: Frank Cass, 2004.

Holdren, John P., and Paul R. Ehrlich. "Human Population and the Global Environment: Population Growth, Rising per Capita Material Consumption and Disruptive Technologies Have Made Civilization a Global Ecological Force." *American Scientist* 62, no. 3 (1974): 282–92. May-June 1974

Howcroft, James. "Intelligence Challenges in Urban Operations." *Small Wars Journal*, July 20, 2014.

Huntington, Samuel P. *The Clash of Civilizations and the Remaking of World Order*. New York: Simon & Schuster, 1996.

"Identify and Assess Integration and Interoperability (I&I) Challenges." MITRE: Systems Engineering Guide. Accessed April 17, 2016. https://www.mitre.org/publications/systems-engineering-guide/se-life cycle-building-blocks/systems-integration/identify-and-assess-integration-and-interoperability-iampi-challenges.

Ikenberry, G. John. *American Foreign Policy: Theoretical Essays*. 4th ed. New York: Longman, 2002.

Integrated Assessment and Planning Handbook. Technical report no. 2014. New York, 2014: United Nations Department of Peace-keeping Operations, 2014.

Jacobs, Jane. *Cities and the Wealth of Nations: Principles of Economic Life*. New York: Random House, 1984.

———. *The Economy of Cities*. New York: Random House, 1970.
Copyright 1969

Jasper, Scott. *Securing Freedom in the Global Commons*. Online-Ausg. ed. Stanford, Calif.: Stanford Security Studies, 2010.

Johnson, Chalmers Ashby. *Revolutionary Change*. 2nd ed. Stanford, Calif.: Stanford University Press, 1982.

Joint Operation Planning. Joint Publication no. 5–0. Washington, DC: U.S. Joint Chiefs of Staff, 2011.

Joint Operations. Joint Publication no. 3–0. Washington, DC: U.S. Joint Chiefs of Staff, 2011.

Joint Publication 1 – Doctrine for the Armed Forces of the United States. Publication no. JP 1. Suffolk, VA: Joint Chiefs of Staff, 2013.

Joint Urban Operations. Joint Publication no. 3-06. Washington, DC: Joint Chiefs of Staff, 2013.

Kahlmeyer, André. "Urban Resiliency, Boots of the Ground vs. Shoes on the Ground." Paper presented at NATO Urbanisation Experiment, Modelling And Simulation Centre of Excellence (M&S COE), Rome, IT, September 25, 2015.

Kaplan, Robert D. *What the Map Tells Us about Coming Conflicts and the Battle against Fate*. New York: Random House, 2012.

———. *What the Map Tells Us about Coming Conflicts and the Battle against Fate*. New York: Random House, 2012.

Kaune, Patrick. *Analysis of U.S. Army Preparation for Megacity Operations*. Carlisle, PA: United States Army War College, 2016.

Kennedy, Christopher A., Iain Stewart, Angelo Facchini, Igor Cersosimo, Renata Mele, Bin Chen, Mariko Ada, Arun Kansal, Anthony Chiu, Kai-gon Kim, Carolina

Dubeux, Emilio Lebre La Rovere, Bruno Cunha, Stephanie Pincetl, James Keirstead, Sabine Barles, Semerdanta Lusaka, Juniati Gunawan, Michael Adegbile, Mehrdad Nazariha, Shamsul Hoque, Peter J. Marcotullio, Florencia Gonzalez Otharan, Tarek Genena, Nadine Ibrahim, Rizwan Farooqui, Gemma Cervantes, and Ahmet Duran Sahin. "Energy and Material Flows of Megacities." *Proceedings of the National Academy of Sciences of the United States of America* 112, no. 19 (April 2, 2015): 5985–90.
Edited by Susan Hanson, Clark University, Worcester, MA

Keohane, Robert O., and Joseph S. Nye. *Power and Interdependence*. 3rd ed. New York: Longman, 2001.

Kilcullen, David. *The Accidental Guerrilla: Fighting Small Wars in the Midst of a Big One*. Oxford [u.a.]: Oxford Univ. Press, 2009.

———. *The Accidental Guerrilla: Fighting Small Wars in the Midst of a Big One*. Oxford [u.a.]: Oxford Univ. Press, 2009.

———. *The Australian Army in the Urban, Networked Littoral*. Russell Defence Offices, A.C.T.: Directorate of Future Land Warfare, 2014.

———. "The City as A System: Future Conflict and Urban Resilience." *The Fletcher Forum of World Affairs* 36, no. 2 (Summer 2012): 19–39.

———. *Out of the Mountains: The Coming Age of the Urban Guerrilla*. Oxford: Oxford University Press, 2013.

———. *The Conduct of Future Operations in the Urban Littoral, and its Implications for NATO*. N.p.: n.p., 2015.

Knox, Paul L. *Atlas of Cities*. Princeton, N.J.: Princeton University Press, 2014.

Kolodner, Janet L. *Case-based Reasoning*. San Mateo, CA: Morgan Kaufmann Publishers, 1993.

Koonings, Kees, and Dirk Kruijt. *Megacities: The Politics of Urban Exclusion and Violence in the Global South*. London: Zed Books, 2009.

Kotkin, Joel. *The City: A Global History*. 2005 Modern Library Edition ed. New York: Modern Library, 2005.

———. *The Next Hundred Million: America in 2050*. New York: Penguin Press, 2010.

Kristol, William. "The Defense Secretary We Have." *The Washington Post* (Washington, DC), December 15, 2004, sec. A, 33.

Laurini, Robert. "Ontologies and Urban Databases." Research Showcase. http://liris.cnrs.fr/robert.laurini/resact/.
Professor Emeritus at INSA Lyon, University of Lyon; President of "Universitaires Sans Frontières/Academics Without Borders" Updated March 2016.

Liotta, P. H., and James F. Miskel. *The Real Population Bomb: Megacities, Global Security & The Map of the Future*. Washington, DC: Potomac Books, 2012.

Lomedico, Mark, and Elizabeth M. Bartels. "City As a System Analytical Framework: A Structured Analytical Approach to Understanding and Acting in Urban Environments." *Small Wars Journal*, August 4, 2015.

Macaulay, David. *Underground*. Boston: Houghton Mifflin, 1976.

Madaj, Patrick. "US Forces Practice Disaster Relief with Allies Japan and Australia." Last modified August 18, 2015. Accessed May 28, 2016. http://www.asiamattersforamerica.org/asia/us-forces-practice-disaster-relief-with-allies-japan-and-australia.

Maher, Brian A., comp. *Special Operations Research Topics 2016*. MacDill Air Force Base, FL: The JSOU Press, 2015.

Malthus, Thomas. *An Essay on the Principle of Population*. Kindle ed. N.p.: Electric Book Company, 1798.

Martin, Grant M. "The Sublime: The Paradox of the 7th Warfighting Function." *Small Wars Journal* November (2013).

Marzluff, John M. *Urban Ecology: An International Perspective on the Interaction between Humans and Nature*. New York: Springer, 2008.

Meadows, Donella H. *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. New York: Universe Books, 1972.

Medby, Jamison Jo, and Russell W. Glenn. *Street Smart: Intelligence Preparation of the Battlefield for Urban Operations*. Santa Monica, CA: Rand, 2002.

Miller, G. Tyler, and Scott Spoolman. *Environmental Science*. 13th ed. Belmont, CA: Brooks/Cole, Cengage Learning, 2010.
Chapter 26- Sustainable Cities Urban Land Use and Management

Miller, John H., and Scott E. Page. *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton, N.J.: Princeton University Press, 2007.

Murray, Williamson. *Military Adaptation in War*. Report no. P-4452. Alexandria, VA: Office of Net Assessment, Office of the Secretary of Defense, 2009.

Neuwirth, Robert. *Shadow Cities: A Billion Squatters, a New Urban World*. New York: Routledge, 2005.

"NATO Urbanisation Project." Accessed May 28, 2016. http://www.act.nato.int/urbanisation.

Norton, Richard J. "Feral Cities." *Naval War College Review* 66, no. 4 (Fall 2003): 97–106.

Nye, Joseph S. *The Future of Power: Its Changing Nature and Use in the 21st Century*. New York: PublicAffairs, 2011.

———. *Is the American Century Over?* Malden, MA: Polity Press, 2015.

———. *The Paradox of American Power: Why the World's Only Superpower Can't Go It Alone*. Oxford: Oxford University Press, 2002.

———. *Power in the Global Information Age: From Realism to Globalization*. London: Routledge, 2005.

———. *The Powers to Lead*. Oxford: Oxford University Press, 2008.

———. *Soft Power: The Illusion of American Empire*. New York: Oxford University Press, 2001.

———. *Soft Power: The Means to Success in World Politics*. New York: Public Affairs, 2004.

———. *Understanding International Conflicts: An Introduction to Theory and History*. 3rd ed. New York: Longman, 2000.

Saaty, Rozanne W. "The analytic hierarchy process—what it is and how it is used." *Mathematical Modelling* 9, no. 3 (1987): 161–176[J1] .

"The 10/40 Window." Map. The Traveling Team. January 1, 2016. Accessed January 18, 2016. http://www.thetravelingteam.org/articles/1040-window.

The Operations Process. Army Doctrine Reference Publication no. 5–0. Washington, DC: Headquarters, Department of the Army, 2012.

Paz, Alon. "Rise of the Feral Adversary." *War on the Rocks*. Last modified November 13, 2014. Accessed September 2, 2015. http://warontherocks.com/2014/11/the-rise-of-the-feral-adversary/.

Pentland, Alex. *Social Physics: How Good Ideas Spread-the Lessons from a New Science*. New York: The Penguin Press, 2014.

———. *Social Physics: How Social Networks Can Make Us Smarter*. New York, NY: Penguin Books, 2015.

Perlman, Janice E. "Mega-Cities, the Urban Poor and the Place of Planning: The Case of Slum Upgrading in Indian Cities." Speech presented at Harvard Graduate School of Design, Cambridge, MA, April 18, 2012. http://www.archdaily.com/281322/lecture-mega-cities-urban-poverty-and-planning-janice-e-perlman. Last modified October 14, 2012. Accessed January 26, 2016.

Ping, Jonathan H. *Middle Power Statecraft: Indonesia, Malaysia, and the Asia Pacific*. Aldershot, Hants, England: Ashgate, 2005.

Plato., G. R. Ferrari, and Tom Griffith. *The Republic*. Cambridge: Cambridge University Press, 2000.

Porter, Patrick. *The Global Village Myth: Distance, War and the Limits of Power*. Washington, DC: Georgetown University Press, 2015.

President of the United States, National Security Strategy, Exec. Doc. (2015).

Questions to Ask Throughout the Experiential Learning Cycle (ELC). Indianapolis, IN: Center for Teaching and Learning: Indiana University-Purdue University Indianapolis Consortium for Learning and Scholarship, 2008.

Randers, Jørgen. *2052: A Global Forecast for the Next Forty Years*. White River Junction, Vt.: Chelsea Green, 2012.

Reader, John. *Cities*. First American Edition ed. New York, NY: Atlantic Monthly Press, 2005.

Reed, Chris, and Nina-Marie E. Lister. *Projective Ecologies*. Cambridge, MA: Harvard University Graduate School of Design, 2014.

Rees, William E. *Carrying Capacity and Sustainability*. Encyclopedia of Life Support Systems. Oxford, England: EOLSS Publishers, 2003.

Robertson, Thomas. *Malthusian Moment: Global Population Growth and the Birth of American Environmentalism*. New Brunswick: Rutgers University Press, 2012.

Robinson, S., Conceptual modeling: Who Needs It?," SCS M and S Magazine (April 2010).

Rogers, Steve., MFR 02/24/2016, Air Force Research Laboratory, Wright-Patterson Air Force Base, OH.

Rothstein, Hy. "Less is More: the problematic future of Irregular Warfare in an Era of Collapsing States." *Third World Quarterly* 28, no. 2 (2007).

Seng, Jocelyn M. "Behavior-Based Network Management (BBNM): A Unique Model-Based Approach to Implementing Cyber Superiority" Working Paper, Air University/SPIE,Montgomery, AL, April 2016

Shoup, Donald C. *The High Cost of Free Parking*. Chicago: Planners Press, American Planning Association, 2005.

Shunk, David. "Mega Cities, Ungoverned Areas, and the Challenge of Army Urban Combat Operations in 2030–2040." *Small Wars Journal*, nos. January 23 (2014). http://smallwarsjournal.com/jrnl/art/mega-cities-ungoverned-areas-and-thechallenge-of-army-urban-combat-operations-in-2030-2040.

Simpson, Dick W., James Dunlap Nowlan, and Betty O'Shaughnessy. *The Struggle for Power and Influence in Cities and States*. Boston: Longman, 2011.

———. *The Struggle for Power and Influence in Cities and States*. Boston: Longman, 2011.

Smith, Daniel J., Kelley Jeter, and Odin Westgaard. "Three Approaches to Center of Gravity Analysis, The Islamic State of Iraq and the Levant." *Joint Forces Quarterly* 78 (3rd Quarterly 2015): 129–36.

SOCOM 2020, Forging the Tip of the Spear. MacDill AFB, FL: United States Special Operations Command, n.d.

Sommer, Henrik. Letter, "Calling Notice For The NATO Urbanisation Experiment, 20–25 Sep 2015 at The Modelling And Simulation Centre of Excellence (M&S COE), Rome," June 25, 2015.

Soni, Vikram. "Water and Carrying Capacity of a City: Delhi." *Economic and Political Weekly* 38, no. 45 (2003): 4745–49.

Soon, Vikram. “Water and Carrying Capacity of a City: Delhi.” *Economic and Political Weekly* 38, no. 45 (November 8, 2003): 4745–49.
This content downloaded from 205.155.65.226 on Thu, 12 Mar 2015 02:03:55 UTC, http://www.jstor.org.

Special Operations. Army Doctrine Reference Publication no. 3–05. Army Doctrine Reference Publication. Washington, DC: Headquarters, Department of the Army, 2012.

Special Warfare Advanced Analysis and Targeting Course. “SWAATC-331-Conflict Assessment and Targeting Framework (CATF), Step 2: Decide.” Working paper, John F. Kennedy Special Warfare Center and School, Fort Bragg, NC, November 2015.

———. “SWAATC-331-Conflict Assessment and Targeting Framework (CATF), Conflict Theory and Conflict Assessment Framework 2.0.” Working paper, John F. Kennedy Special Warfare Center and School, Fort Bragg, NC, November 2015.

Staggs, Brad. “NATO Urban Operations Working Group hosted by Muscatatuck.” Atterbury Muscatatuck. Last modified April 23, 2014. Accessed February 4, 2016. http://www.atterburymuscatatuck.in.ng.mil/NewsMedia/LatestNews/NATOUrbanOpsGroup.aspx.

Strange, Dr. Joe and Iron, Colonel Richard. “Understanding Centers of Gravity and Critical Vulnerabilities, Part 1: What Clausewitz Really Meant by Center of Gravity” Accessed 18 March 2016. http://www.au.af.mil/au/awc /awcgate/usmc/cog1.pdf.

Strange, Dr. Joe and Iron, Colonel Richard. “Understanding Centers of Gravity and Critical Vulnerabilities, Part 2: The CG-CC-CR-CV Construct: A Useful Tool to Understand and Analyze the Relationship between Centers of Gravity and their Critical Vulnerabilities” Accessed 18 March 2016. http://www.au. af.mil/au/awc/awcgate/usmc/cog2.pdf.

Stanley, Bruce. “Wargames, Training, and Decision-Making. Increasing the Experience of Army Leaders.” Master’s thesis, School of Advanced Military Studies United States Army Command and General Staff College, 2000.

Taiyab, Nadaa. *Transportation in Mega-Cities: A Local Issue, A Global Question*. The Fredrick S. Pardee Center for the Study of the Longer-Range Future. N.p.: n.p., 2008.
www.bu.edu/pardee

The White House, National Security Strategy, Exec. Doc. (2015). February

Tomes, Robert. “The Cold War Offset Strategy; Origins and Relevance.” *Small Wars Journal, War on the Rocks*, November 6, 2014.

Troxell, John, comp. *2015–16 Key Strategic Issues List*. Carlisle, PA: Strategic Studies Institute and U.S. Army War College Press, 2015.

Unified Land Operations. Army Doctrine Reference Publication no. 3–0. Washington, DC: Headquarters, Department of the Army, 2012.

United Nations World Health Organization. *WHO’s Ambient Air Pollution Database-Update*. Public Health, Social and Environmental Determinants of Health Department update 2014. Geneva, Switzerland: World Health Organization, 2014.

United Nations, World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. Technical report no. ESA/P/WP.241. N.p.: United Nations, Department of Economic and Social Affairs, Population Division, 2015.

United Nations, World Urbanization Prospects, The 2014 Revision Methodology. Technical report no. WP.238. New York, NY: United Nations, 2014.

United Nations, World Urbanization Prospects: The 2014 Revision. New York: United Nations, 2014.

United States Army. *Unified Land Operations*. Army Doctrine Reference Publication no. 3–0. Washington, DC: Headquarters, Department of The Army, 2012.

———. *Urban Operations*. Field Manual no. 3-06. Washington, DC: Headquarters, Department of the Army, 2012.

Vinnitskaya, Irina. “Lecture: Mega-Cities, Urban Poverty and Planning / Janice E. Perlman.” *Arch Daily*, October 14, 2012. http://www.archdaily.com/281322/lecture-mega-cities-urban-poverty-and-planning-janice-e-perlman

Vlahos, Michael. “Eyeless in Gaza – Are We Blind to an Enduring Reality of War?” War On The Rocks. Last modified August 20, 2014. Accessed January 29, 2016. http://warontherocks.com/2014/08/eyeless-in-gaza-are-we-blind-to-an-enduring-reality-of-war/.

Watson, Ian, and Farhi Marir. “Case-Based Reasoning: A Review.” AI-CBR, Dept. of Computer Science, University of Auckland, New Zealand. Accessed April 17, 2016. http://ai-cbr.cs.auckland.ac.nz/classroom/cbr-review.html#History of Case-Based Reasoning.

Weinberg, Alvin. “Let Us Prepare for Peace.” *Bulletin of the Atomic Scientists* 24 (September 1968): 17–20.

Weissman, David. *Cities, Real and Ideal: Categories for an Urban Ontology*. Frankfurt: Ontos Verlag, 2010.

West, Geoffrey B. “Why Cities Grow, Corporations Die, and Life Gets Faster.” Lecture, Long Now Foundation, San Francisco, CA, October 11, 2011. Post-lecture interview by Stewart Brand; http://www.abc.net.au/tv/bigideas/stories/2011/10/11/3336172.htm.

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